

TROPICAL AGRICULTURE



By
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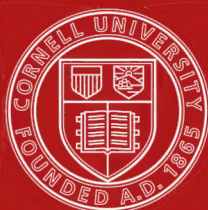
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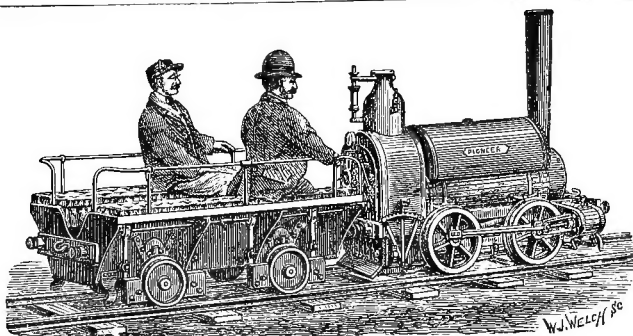
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TROPICAL AGRICULTURE.

A TREATISE

ON THE

CULTURE, PREPARATION, COMMERCE, AND
CONSUMPTION OF THE PRINCIPAL PRODUCTS
OF THE VEGETABLE KINGDOM.

By *Peter* P. L. SIMMONDS, F.L.S., F.R.C.I.,

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APPLIED SCIENCE AND NATURAL HISTORY.

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PREFACE TO THE THIRD EDITION.

THE necessity for a descriptive work of reference of this kind, treating exhaustively on the culture, preparation, and consumption of the principal staples of commerce furnished by the Vegetable kingdom, is proved by the sale of several large editions. That published about twelve years ago being exhausted, I have been requested to prepare another, bringing down the statistical and general information to the present time.

So many changes have, however, taken place, even in this short interval, in the seats of production, the nature and extent of the cultures, and in additions made to our Colonial Possessions, that an entirely new work is almost required, or at least very material changes in the notices of the principal products of commerce.

Steam navigation has made great progress, and the Suez Canal and increased speed attained have shortened the route to India, the Eastern Archipelago and Australasia, while submarine cables have now brought almost all distant countries within a few hours' communication of each other. These improvements have had an enormous stimulating effect upon Commerce and Agriculture, coupled with the vast extension of railways.

We have added to our Colonial Possessions Fiji, New Guinea, Burma, North Borneo, and Cyprus. Great Britain, Belgium, Italy, and Germany are extending their colonising influence in Africa, so as to open up that vast Continent more generally to Commerce. A large emigration has taken place in the last ten years to North and South America, and Australasia.

The Colonial and Indian Exhibition, held in London in 1886, brought prominently before the British public the capabilities of our various possessions to supply us with almost all that we require.

The consumption of the dietetic articles and cereals, fruits, wines, spirits, cils, &c., necessarily increases with the growth

of population, hence the period under notice shows large advances. A few instances of progress in the world's production in eleven years may be cited :—

	1876.	1887.
Sugar tons	3,665,000	6,177,000
Tea lbs.	1,290,037,000	1,444,000,000
Coffee cwts.	11,500,000	14,000,000
Cacao lbs.	60,000,000	82,500,000
Rice tons	..	2,500,000
Maize bushels	1,300,000,000	2,000,000,000
Oil seeds cwts.	..	17,300,000
Palm oil "	864,472	1,000,000
" kernels tons	25,192	36,000
Coconut oil cwts.	250,000	318,454

Coffee planting in the British Colonies has retrograded owing to the immense production in Brazil and the decline in European consumption. Tea, on the contrary, is increasing in demand, and the planters of India and Ceylon have thrown themselves with such energy into the industry, that they already produce more than half the quantity required for the United Kingdom, and of a far superior quality to the Chinese tea.

The culture and commerce of many of the principal dye-stuffs of India have been almost annihilated by the coal-tar colours.

Some new products have come largely into commerce of late years, among which may be mentioned the Cinchona barks, cardamoms, the kola nut, &c. The demand increases for the elastic gums, caoutchouc, and gutta-percha, and the same may be said of tobacco, the consumption of which largely progresses in all countries. The British imports are now :—

Caoutchouc cwts.	220,350
Cotton "	15,462,099
Peruvian bark "	144,820
Gutta-percha "	22,483
Liquorice "	34,831
Nuts for expressing oil tons	62,932

The failure of the wine crop in Europe a few years ago led to increased attention being given to the manufacture in Australia, Cyprus, and the Cape Colony, as well as in parts of North and South America. The fruit trade of our Colonies has also received more attention, so that shipments are now profitably made to Europe, and these are extending.

The great increase which has taken place in our imports in some of the principal commodities is shown by the following

comparative figures, although these are not all consumed in the United Kingdom :—

		1876.	1888.
ARTICLES OF FOOD, ETC.			
Cacao	lbs.	20,382,308	31,550,245
Coffee	cwts.	1,341,378	949,330
Tea	lbs.	185,698,190	222,758,296
Sugar	cwts.	15,587,246	25,209,949
Molasses	"	496,357	345,894
Brandy	galls.	7,953,913	2,655,004
Rum	"	10,476,503	4,146,564
Wine	"	19,969,838	14,745,161
Maize	cwts.	39,958,226	25,370,164
" meal	"	7,706	14,745
Rice	"	6,485,987	6,189,644
Sago	"	360,357	426,346
Unenumerated spices ..	lbs.	4,200,000	16,153,000
Cinnamon	"	1,339,508	1,346,990
Ginger	cwts.	62,164	68,743
Pepper	lbs.	26,059,030	28,679,221
Pimento	cwts.	35,710	50,000
Currants, raisins, and figs	"	1,714,445	1,783,029
Oranges and lemons ..	bush.	2,995,328	4,861,061
Tobacco	lbs.	..	52,302,572
ARTICLES FOR MANUFACTURES, ETC.			
Oil-seeds	qrs.	2,457,348	2,811,267
Cotton-seed	tons	230,284	257,172
Oil-seed cake	"	190,225	257,748
Coconut oil	cwts.	199,431	194,025
Olive oil	tuns	23,975	18,535
Palm oil	cwts.	864,472	953,799
Manila hemp	"	300,798	693,797
Jute	"	..	313,828
Gambier and cutch ..	tons	26,677	28,543
Indigo	cwts.	88,680	78,128
Madder and garancine ..	"	74,535	14,204
Safflower	"	..	1,628

Although the title of 'Tropical Agriculture' has been maintained for the book, yet it will be found to embrace incidental mention of a few extra-tropical cultures and productions, such as maize, madder, beetroot sugar, Paraguay tea, tobacco, &c., which are important in their nature, although many of them are carried on beyond the limits of the Tropics.

Since the body of this work was printed, I have received a copy of a pamphlet containing the recent official reports of the various American consuls on the production of Coffee in the States of Central and South America and the West Indies, and it will be interesting to place on record their estimates made on the spot, and therefore under special advantages.

	Lbs.
Vera Cruz	15,866,000
Tampico	400,000
Costa Rica	44,800,000
Guatemala	50,000,000
Honduras	2,240,000
Salvador	18,000,000
Nicaragua	10,000,000
Brazil	840,000,000
Ecuador	4,000,000
Peru	560,000
Colombia	17,000,000
Venezuela	60,000,000
Jamaica	8,360,800
Cuba	1,850,627
Porto Rico	43,000,000
Hayti	100,000,000
San Domingo	7,652,343
Martinique and } Guadaloupe }	6,500,000
	1,230,229,770

If we add to the above figures the production of coffee in the Eastern hemisphere, we get at a pretty fair estimate of the production of the world:—

	Lbs.
Java	175,500,000
Sumatra and Celebes	40,500,000
Philippines	8,400,000
Ceylon	31,360,000
India	31,355,487
Africa and Arabia	15,232,000
Pacific Islands	33,000,000
	335,347,487

This brings out a total of 1,565,577,257 lbs., or 700,000 tons, which approximates closely to the estimate of Messrs. Rucker & Co., given on page 30.

P. L. SIMMONDS.

85, FINBOROUGH ROAD, SOUTH KENSINGTON,
October, 1889.

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COMMERCIAL PRODUCTS

OF THE

VEGETABLE KINGDOM.

SECTION I.

PLANTS YIELDING SEEDS, LEAVES, AND OTHER SUBSTANCES EMPLOYED IN DOMESTIC USE FOR THE PREPARATION OF INFUSED DIETETIC BEVERAGES, ETC.

No substances are so essentially necessary and useful to mankind, or form such important articles of commerce, as those which I propose first to consider, Cacao, Coffee, Tea, and Sugar. The consumption of these in all civilised countries is immense, notwithstanding that in many they have been fettered with heavy fiscal duties. The description of the culture of the plants from which they are obtained, the manufacture of the products, and the statistics of commerce, are the subjects to which it is intended to give most attention, glancing only incidentally or occasionally at their early history.

CACAO.*

Botanical Description and Chemistry of Cacao.—The cacao, or cocoa, of commerce is the seed of an evergreen tree, the *Theobroma Cacao* (Lin.), growing from fifteen to forty feet high. There are nine or ten other species, however, enumerated by botanists, of which I may name *T. angustifolia*, Dec., and *T. ovatifolia*, Dec. (the Soconosco), of Mexico; *T. bicolor*, Humboldt, of New Granada; *T. Guianensis*, Aublet, of Guiana; *T. Caribæa*, of the West Indies; and *T. microcarpa*, Mart.; *T. speciosa*, Willd., Para; *T. subincana* and *sylvestris*, Martius, of Brazil.

The fruit, or pod, resembles a short, thick cucumber, and contains from twenty to forty seeds enclosed in a pulp, somewhat like that of a water-melon. This pulp is frequently used for food and sweetmeats; vinegar is also made of it. In the Brazilian collec-

* I have adopted this spelling to distinguish it from the numerous other cocoas of commerce.

tions at the various International Exhibitions, spirits, liqueurs, jellies, &c., made with cacao, have been shown.

When Cortez and the Spaniards entered the vast empire of Montezuma, they found the use of cacao or chocolate as a beverage common. The emperor, however, alone drank it flavoured with vanilla from a golden cup. A legend surrounds with religious veneration this sacred beverage, and when Cortez sent to Charles V. the principal products of the New World, he did not omit cacao as the most healthy of the beverages which Spain obtained by its conquests. The conquerors were not slow to appreciate its excellent qualities, and introduced it into Spain.

Spain, however, for some time depended on the colonies for the manufactured articles, but when the art of preparing it was conveyed there, the raw material was also imported. The Spaniards, by jealously guarding as a secret the mode of manufacture, were able to retain the monopoly of the trade in chocolate for many years.

The value of chocolate was speedily appreciated by the physicians of Europe, and Hoffmann wrote a monograph treating of it, entitled '*Potus Chocolati*,' in which he recommends it in many diseases, and instances the case of Cardinal Richelieu, who, he states, was cured of general atrophy by its use.

It was probably more than a century after the introduction of cacao into Europe before the English became acquainted with it. According to Mr. Hewett, the earliest mention of its use appears in a newspaper called Needham's '*Mercurius Politicus*,' dated the 16th of June, 1659. For many years England continued to import all the chocolate she consumed in its manufactured state; but about the commencement of last century several persons commenced the manufacture in this country. There is very strong reason to believe that a knowledge of the mode of preparation was brought into England by Sir Hans (then Dr.) Sloane.

Cacao or Chocolate is, without exception, of all domestic drinks, the most alimentary, and the Spaniards esteem it so necessary to the health and support of the body, that it is considered the severest punishment to withhold it, even from criminals; nay, to be unable to procure chocolate is deemed the greatest misfortune in life. The signs by which good chocolate or cacao is known are these. It should dissolve entirely in water, and be without sediment; should be oily and yet sweet in the mouth, and if genuine and carefully prepared, should deposit no grits or grounds.

The bean of the cacao owes its properties in the first place to a nitrogenous substance, theobromine, and next to the ternary compounds oils and starch. It also contains a large quantity of phosphate of lime, which adds no doubt to its qualities as food. The quantity of volatile substance it contains is small, though it may, to some slight degree, be increased by roasting.

The chemical composition of cacao is shown in tables printed in later pages, which give the different analyses of any importance that have been made.

The results given are not very flattering to chemical science,

the analyses being of the most contradictory character, and containing discrepancies which cannot be at all reconciled with each other. It appears to me that the analysis prepared by Sir Lyon Playfair is the most correct, while those of Tuchen and Muter are the least so. We thus see that, taking the most important constituents, cacao contains :

	Parts.
Cacao butter	50
Albuminoid substances	20
Starch, sugar, &c.	13
Salts	4
Theobromine	2
Other substances	11
	100

Examining these in the order of their importance, we first notice the fat, or cacao butter, which forms about half the substance of the nibs. It is a hard, fatty material, which, when clarified, is of a dead white colour. Its melting point is about 100° Fahr., which, being the heat of the body, renders it of great value for therapeutical purposes. This fat never becomes rancid, however long it may be kept, a quality peculiar to itself. It is hardly necessary to point out how valuable this property is, for it places cacao butter first in the list of the fatty class of our carbonaceous or heat-giving foods. The albuminoid constituents form about 20 per cent. of the nib. These are classed amongst the nitrogenous principles of food, and their presence renders cacao one of the richest flesh-formers we have. The starch, gum, and sugar present, like the cacao butter, belong to the nonazotised principles; they form about 13 per cent. of the whole. The alkaloid of cacao, *theobromine*, is very similar in its physiological effects to its analogues, *theine* and *caffeine*, from which it differs but slightly in chemical composition.

ESSENTIAL ALKALOID PRINCIPLES.

Yielded by	Name.	Composition.	Proportion.
Cacao	Theobromine	$C_7 H_8 N_4 O_2$	1½ to 2 per cent.
Coffee	Caffeine	} All identical $C_8 H_{10} N_4 O_2$	} 1 to 5 per cent.
Tea	Theine		
Guarana	Guaranine		
Maté	Theine	..	1½ per cent.

In regard to these alkaloids, it is interesting to note that throughout the world the instinct of man has led him to seek some substance that contains one of these principles, which owe their value to the specific influence they exert on the nervous system, stimulating it and checking waste of tissue. *Theobromine*, when extracted, presents the form of a white powder of almost amorphous

PERCENTAGE ANALYSES OF CACAO.

	Lampadius.	Tuchen.	Puyen.	Johnston.	Playfair.	Miller.	Boussingault.	Mitscherlich.		Muter.	Average of several other Analyses.
Fat (cacao butter)	53.10	36.97	52.00	51.00	50.00	56.00	44.00	45.00	49.00	42.67	50.00
{Albuminoid substances	18.70	..	20.00	..	..	17.00	..	13.00	18.00	..	..
Albumin	..	..		..	20.00	..	20.00	..	..	..	18.00
Fibrin	..	..		..	..	..	..	..	..	..	
{Gluten	..	30.20	..	20.00	..	..	..	..	..	12.21	..
Extractive matter	..	4.14	..	..	..	..	..	..	..	..	..
Sugar	..	..	..	..	..	..	..	0.60	..	..	..
Starch	10.91	0.55	10.00	22.00	7.00	..	..	14.00	18.00	19.03	10.00
Gum	7.75	0.69	..		6.00	..	6.00	..	..	6.40	8.00
{Lignin	0.90	..	..	..	..	22.00	13.00	..	..	..	..
Cellulose	..	30.00	2.00	..	..			6.08	..	5.95	..
{Woody fibre,	..	..	..	..	4.00	..	..	..	..	..	..
Colouring matter	2.01	6.61	traces	..	2.00	..	..	3.05	5.00	3.95	2.60
Water	5.20	6.01	10.00	5.00	5.00	..	11.00	5.06	6.30	5.98	6.00
Tllobromine	..	0.56	2.00	2.00	2.00	1.50	2.00	1.02	1.50	0.90	1.50
Salts	..	3.00	4.00	..	4.00	..	4.00	..	..	..	..
Ash	..	..	..	..	..	..	..	3.05	..	2.90	3.60
{Humic acid	..	7.25	..	..	..	..	..	..	..	..	..
{Parts not accounted for	1.43	1.02	..	..	..	3.50	..	9.14	..	..	0.30

character, differing from *caffeine* and *theine*, which have a very beautiful crystalline appearance.

In most of the analyses of cacao the existence of a volatile oil has been overlooked. It is probably present only in small quantities, and appears to be developed by roasting; but upon it depends the flavour and aroma which exist in cacao.*

Mr. Charles Heisch, F.C.S., in a paper "On the Composition of Various Kinds of Cacao," observes: "It is well known that different varieties of cacao fetch very different prices; but as far as I am aware, no careful examination has been made to ascertain if these variations are caused by any difference in their composition regarded as articles of food, or if they be due solely to differences in flavour, which, after all, may be only matters of taste. In none of the published analyses of cacao which I have seen is any mention made of the kind of bean analysed, it is therefore not surprising that the results published vary very considerably. Thus, while in Dr. Hassall's book we are told that cacao contains albuminoid matter 16·7 per cent.; in Dr. Parkes' Practical Hygiene it is stated to contain from 13 to 18 per cent. of protein substance. In neither case is it mentioned whether the bean was examined raw or after roasting. Having, through the kindness of a friend, obtained samples of various cacao beans, both raw and roasted, which he assured me were unmixed, I made a number of analyses of the roasted beans. The results are shown in the following table. They are not so complete as I had hoped to make

	Per-centage of Husk.	RESULT OF EXAMINATION OF ROASTED BEAN AFTER REMOVAL OF HUSK.								
		Fat.	Nitro-gen.	Albumi-noid sub-stances.	Ash.	Ash soluble in water.	Ash soluble in HCl.	Phosphoric Acid in Ash, calculated as $H_3 PO_4$.	Mois-ture.	Starch, Gum, Cellu-lose, &c.
Caracas ..	13·8	48·4	1·76	11·14	3·95	2·15	1·80	1·54	4·32	32·19
Trinidad† ..	15·5	49·4	1·76	11·14	2·80	·9	1·90	·93	3·84	32·82
Surinam ..	15·5	54·4	1·76	11·14	2·35	·80	1·55	1·23	3·76	28·35
Guayaquil ..	11·5	49·8	2·06	13·03	3·50	1·75	1·75	1·87	4·14	30·47
Grenada ..	14·6	45·6	1·96	12·40	2·40	·60	1·80	1·35	3·90	35·70
Bahia ..	9·6	50·3	1·17	7·40	2·60	·90	1·70	1·26	4·40	35·30
Cuba ..	12·0	45·3	1·37	8·67	2·90	·95	1·95	1·13	3·72	39·41
Para ..	8·5	54·0	2·00	12·66	3·05	1·40	1·65	1·00	3·96	26·33

† I am inclined to think that the Trinidad sample was not of the finest quality.

them, but they comprise the more important constituents. In the first column of the table is noted the proportion of husk in the several varieties. This difference appears to be mainly due to the husk in some kinds being much thicker than in others; in all cases these thick husks separate more readily from the bean in the process of roasting, and can be taken off with much greater facility.

* Mr. John Holm "On Cocoa and its Manufacture," 'Journal of the Society of Arts,' vol. xxii. p. 356. 1874.

The other estimations are made on the roasted bean after removal of the husk. The albuminoids are calculated from the total nitrogen found by combustion with soda lime; the nitrogen contained in the theobromine is thus included, but in the roasted bean this is so small that the difference is hardly worth consideration; hereafter, I hope to estimate the theobromine in the different varieties, as well as the starch, gum, cellulose, &c. It will be observed that in none of the above samples do the albuminoid substances reach the amount mentioned by Hassall or Parkes, but, as neither of them give the method by which the albuminoids were ascertained, no attempt can be made to account for the difference. The amount of these substances in Para cacao, which is about the lowest-priced variety, is, with one exception, the highest in the table, so that, viewed as an article of food, it is superior to some of the more expensive kinds. The soluble ash consists, to a great extent, of phosphate of potash, the phosphoric acid in the portion insoluble in water being mostly, if not entirely, combined with magnesia."

G. Wolfran, of Dresden, published in 1878 an investigation into the chemical constituents of different kinds of cacao in continuation of the inquiries of A. Mitscherlich in his "Cacao and Chocolate," Berlin, 1859. The following are the published results of 100 grammes husked and dried.

	Ashes.	Fat.	Theobromine.
Caracas	3·68	53·8	1·63
Guayaquil	3·81	50·6	1·63
San Domingo	3·02	51·5	1·66
Bahia	3·35	51·7	1·64
Porto Cabello	3·59	49·9	1·46
Tabasco	4·33	52·6	1·34

Production and Consumption.—The cacao production of the world may be set down as follows, according to the latest returns :

	Lbs.
Brazil	14,000,000
Venezuela	14,300,000
Ecuador	22,500,000
Trinidad	20,000,000
Grenada	2,500,000
Dominica	200,000
St. Lucia	260,000
Jamaica	370,000
French Guiana	60,000
Guadaloupe	567,000
Martinique	970,000
Hayti and St. Vincent	3,400,000
Mexico	2,000,000
Celebes and Netherlands-India	250,000
Ceylon and India	1,100,000

Cacao and chocolate are comparatively little used in the United Kingdom, compared with the other articles employed for dietetic beverages. The quantity taken for consumption in 1888 was over 18,000,000 lb., or about half a pound for each person of the population. Still, it is gradually on the increase, as will be seen by the following statistics, showing the annual quantity consumed and the percentage of consumption per head of the population in the kingdom.

When we consider that the imports of cacao into this country in each of the years 1887 and 1888 were over 28,000,000 lb., there was an abundant supply to fall back upon, had there been a commensurate demand. Looking at the small consumption here, and that there is only the Continental market to depend upon, there is but little encouragement to our colonial planters to extend the production.

The value of the cacao imported annually into the United Kingdom is about 930,000*l*. The quantity now received here ranges between 27,500,000 and 29,500,000 lb., 18,000,000 of which is kept for use in Great Britain.

The following gives the quantity of cacao annually retained for consumption in the United Kingdom, and the average consumption per head of the population:

					Total Consumption.	
					Lbs.	Average Lb.
1840	..	..	..	..	2,641,470	0·08
1850	..	..	..	..	3,080,641	0·11
1860	..	..	..	..	4,585,124	0·11
1870	..	..	..	..	6,943,102	0·20
1880	..	..	..	..	10,566,189	0·30
1887	..	..	..	..	15,878,098	0·43
1888	..	..	..	..	18,227,017	0·50

The duty on raw cacao imported is 1*d*. per lb., and on prepared 2*d*. per lb.

The total imports of cacao into the United Kingdom in 1886 were drawn from the following countries:—

	Lbs.
The Continent	3,872,739
Hayti and St. Domingo	324,780
Central America and Colombia	343,225
Venezuela	80,859
Ecuador	6,032,874
Brazil	447,634
Other Foreign Countries	671,168
British East Indies	1,223,810
British West India Islands	11,998,808
British Guiana	362,018
Other British Possessions	5,528
	25,363,443

Spain is the largest consumer of cacao, although England, France, and Holland now use much.

The following have been the imports of cacao into Spain of late years, which gives an average of nearly 1 lb. per head.

Spain.—Cacao imports in kilos of 2½ lb.

1874	6,648,000	1881	5,502,000
1875	4,272,000	1882	6,858,000
1876	5,702,000	1883	6,052,000
1877	6,390,000	1884	7,372,000
1878	5,324,000	1885	7,201,000
1879	5,937,000	1886	7,154,000
1880	8,471,000		

The total importations of cacao into France were in—

					Of which were received in Marseilles.	
					Kilos.	Kilos.
1883	..	..	..	15,662,289		190,161
1884	..	..	..	17,566,718		258,104
1885	..	..	..	15,459,031		231,493
1886	..	..	..	18,601,890		486,902

France receives a good deal from Brazil.

There are about ten chocolate and cacao manufacturers in Holland, whose yearly requirements of cacao beans may be estimated at 3000 tons in round figures, principally of the Guayaquil, Caracas, and Domingo kinds. They mostly manufacture cacao preparations, known by the name of soluble cacao, cacaotina, and cacao powders, viz. the roasted and powdered cacao beans deprived of most of their natural fat, which is used as a valuable ingredient by manufacturers of chocolate, cacao sweetmeats, and also for pharmaceutical purposes.

The oldest of the Dutch cacao works was founded on a small scale more than a century ago, and most of the other works have existed from forty to sixty years, but all of them remained insignificant until the above-named powdered preparations found their way to foreign countries, especially England and Germany, where certain Dutch brands of powdered cacao have been very well received and enjoy a large sale. In 1886 the imports of these from Holland were over one million pounds, and from France, Belgium, and other countries 332,000 lb. more.

There are people who suppose that the superiority of Dutch cacao powder is to be attributed to a peculiar mode of manufacture, different from the methods followed in other countries. In England there are over a dozen cacao and chocolate manufacturers who work up over 15,000,000 lb. of raw beans, of this 13,000,000 lb. come from the West Indies and British Guiana.

The idea to extract the fat from the roasted cacao beans and to sell the powder is said to have originated in the brain of a Dutch chocolate maker about 1830.

Monday, October 4th, 1887, 25 tons of cacao butter were sold by one maker in Holland, and 30 tons by another maker in London. The time is not so far back when all the makers of cacao powder in Holland did not produce 50 tons of butter a year, and when an order for cacao beans was usually combined with the condition that 10 per cent. of the value of the order should be taken out in

butter of cacao, a condition which in many cases was refused by the selling party, who found it too dangerous to keep a stock of a few hundred pounds of cacao butter. In 1883, 2000 tons of cacao butter were produced in Holland.

In two ordinary varieties of cacao, lately analysed fresh from the pod by Mr. McCarthy, the Government analyst, the fat was only 18 per cent. in one, while in the other it was over 28 per cent. Theobromine being in nearly the same proportion.

M. Menier, the principal manufacturer of chocolate in France, produces about 18,000 lb. a day. When he started his factory some 60 or 70 years ago, cacao nibs were imported, but in small quantities, into France. The better specimens from Venezuela, Nicaragua, Guatemala, and Mexico were sent to Spain, where the monopoly of the best chocolate was retained, as well as the reputation of a superior manufacture. Now Holland, France, and England surpass Spain in the excellence of the manufacture. In those early days the use of chocolate was limited to the upper classes, the middle and lower classes using it only in cases of sickness. Some time ago the late M. Menier purchased a very extensive estate in Nicaragua, and began the experiment of culture on a large plantation, which is in a very flourishing state.

In Spain the two principal manufacturing companies are the Colonial, at Pinto, near Madrid, on the Mediodres railway, and that of Matias Lopez, at San Lorenzo (Escorial) in Madrid. The latter has a magnificent building of 60,000 square yards, and ten years ago worked up 2,500,000 lb. of chocolate annually; it has since kept pace with the increased consumption of the country.

HAMBURG.

Cacao imports in bags.

	1886.	1885.
Guayaquil	44,925	35,807
Para	—	300
Bahia	1,276	3,618
Cape Haiti	9,200	11,000
Samana	2,261	2,370
Trinidad	2,067	4,952
Caracas	4,574	5,470
Carupano	1,473	1,464
Surinam	479	1,432
Grenada	—	—
St. Thomas	6,952	6,593
Angostura	125	50
Maracaibo and Cauca	1,271	598
Ceylon	2,895	262
Peru	393	—
	87,891	74,583

Culture in Trinidad.—The following practical remarks are furnished me by Mr. John McCarthy, F.C.S. of Trinidad:—Cacao thrives well in almost every quarter of the Island, the moist shady quiet valleys being exactly suited to its cultivation. To grow cacao to perfection a good rich soil, which is to be found on all sides, and

especially in the virgin forests, must be acquired, and the land felled and partially cleared. Of all tropical cultivation that of cacao is by far the most suited to the habits of Europeans. From the first the cacao tree must be grown in the shade with the object of maintaining the moisture of the soil which is an essential element. The result is that on coming into bearing at say the fourth year and onwards the planter and labourers have the whole of their work to perform perfectly protected from the rays of the sun. The cacao plantations at the age of six or seven years, when the trees begin to meet overhead, makes a perfect picture. The trunks of the trees displaying various shades of grey and green, the leaves a bright dark green, and the pods from seven to ten inches long, and in shape more or less like a coconut—there are always some ripening, while at the same time the blossom has only just formed on another part of the tree, the pods are of various colours, pink, grey, orange, crimson, scarlet, and hanging from all parts of the branches and stem, some hanging in a cluster round the foot of a tree, contribute to form a picture which lingers pleasantly on the mind. The cacao trees are planted on an average about 13 feet apart, which gives about 260 trees to the acre. In the fourth year, with careful planting and attention, one bag of cacao, weighing $1\frac{1}{2}$ cwt. net, should be obtained per acre. This will increase every year until the eighth and onwards, when $2\frac{1}{2}$ bags should be obtained; $2\frac{1}{2}$ bags will net in London after paying all expenses, freight, and charges, 12*l.* 10*s.*; deducting yearly cost of cultivation, and preparation and transport, 5*l.*; leaves, profit per acre, 7*l.* 10*s.*, and this will go on practically for any length of time up to seventy years or more. The quality of cacao produce from old trees is considered better than that from young ones, and the cost of cultivation less. An acre of new land to fell, clear, and plant cacao, shade trees, corn, or other minor industry between the spaces will cost, including dwellings for labourers and managers, about 7*l.*; add to this four years' cultivation, weeding, pruning, &c., 30*s.*, 6*l.* = 13*l.* The first crop 1 bag per acre netting the planter, after paying all expenses for the year's freight, and charges a profit of 3*l.* per acre. This will gradually increase year by year, until by the eighth year the cost and profit will be as follows:—Cost to the fourth year as above 13*l.*; add four more years' cultivation, 6*l.*, = 19*l.*; and the profit as shown above will be 7*l.* 10*s.* It is estimated and well known to be a fact that money invested in cacao cultivation will double itself in value in five years, plus interest.

As regards the commercial aspect, the following are a few interesting facts:—During the last few years of depression cacao is one of the few articles of tropical produce which has kept its value in the market. Tea, coffee, sugar, and cinchona, and other leading articles produced in the tropics have fallen at times to almost ruinous prices, but the value of Trinidad cacao has scarcely varied more than 1*s.* or 2*s.* per cwt. during the period named. This proves that the demand in Europe is steady and increasing, and the production not overdone, on account of the few places in the

world suitable for its cultivation, and perhaps the comparatively long time required to bring the tree into bearing. The official returns for the last few years are appended below.

ENGLAND.

	1886.	1885.	1884.	1883.	1882.	1881.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Imported.. .. .	11,328	10,560	10,120	10,104	8,478	9,986
Deliveries for home consumption	6,764	6,520	6,234	5,745	5,356	4,865
Exported.. .. .	3,000	3,840	3,555	3,652	3,729	4,353

FRANCE.

	1885.	1884.	1883.	1882.	1881.
	Tons.	Tons.	Tons.	Tons.	Tons.
Imported	15,230	17,307	15,430	17,574	17,806
Duty-paid	12,120	12,018	12,700	11,430	12,000
Exported	4,950	3,488	4,396	3,660	4,628

Established cacao estates in Trinidad are very highly valued as may be gathered from the fact that, for years, the fixed price was one dollar (4s. 2d.) per tree, but lately the price has been raised \$1.20 to \$1.50 (5s. and 6s. 3d.). The value of an acre with 260 trees five years old can therefore be easily reckoned. Even at these prices, to purchase an established estate would be a fine investment for the capitalist, giving the purchaser from 10 to 12½ per cent. yearly income on the money invested. It is much better therefore for the planter who can begin at the beginning and can afford to wait until his young trees come to the bearing stage.

The country that produces by far the largest crops of cacao is Ecuador, known as Guayaquil cacao (Guayaquil being the shipping port). When, for some reason, such as drought, the Guayaquil crops fall short, Trinidad cacao will rise to 100s. or even 130s. per cwt., which has happened during the last few years. The present or normal value of good estate cacao from Trinidad is 82s. to 85s., on which figures I have based my calculations of profits, and a notable fact is that, in spite of the imports into Europe during the last six months of 1886 from Guayaquil being on an unusually large scale, and a consequent great drop in the price of Guayaquil cacao, still the price of Trinidad has held its own. This is owing to the peculiar flavour of Guayaquil not being at all suitable to the requirements of English manufacturers. Of course there are always risks to be reckoned for in this, as in all cultivation, both in Trinidad and elsewhere. Dry weather may prevent the blossom forming fully, and a short crop will be the result. Heavy rains occur sometimes when dry weather is needed to ripen the pods, and the result is the cacao harvested will be inferior in quality, but,

as regards disease to the trees, there is no record, as far as is known, of cacao trees in Trinidad having suffered from any permanent disease, and it has been grown in the island for over 160 years, though only extensively during recent times. There are more ways than one for forming a cacao estate, and the common one adopted, though not the best, is after purchasing the land to let it out in blocks to negro and coolie contractors. They clear the land and plant it up with cacao, their source of profit being the vegetables, corn, fruit, &c., which they grow as market gardeners between the young trees for local sale. At the end of four or five years the contractors give back the land to the owner, who thereupon pays them at the rate of about 1s. per cacao tree. An acre of 260 trees will thus cost the owner 13*l.*, which is the same as if he had planted it himself with his own paid labour. This contract system is more specially suitable for the planter without all the necessary funds available to extend the cultivation himself with his own paid labour, or for the owner non-resident, who cannot or does not care to supervise the planting of his estate. But by far the best plan is for the European proprietor to open the land himself, under the supervision of an experienced manager, for although it entails an immediate outlay of capital which will lie dormant for four years, still it has been distinctly proved, and is only natural, that cacao trees will receive better treatment under the master's eye and come into bearing earlier and more regularly than if left to a contractor, who has no direct personal interest in the welfare of the cacao. Besides which it is clear that if the contractor can make a good living out of the corn, &c., why should not the owner do the same."

The distance at which trees should stand apart will be modified to some extent by the altitude at which they grow, and by the different habit of growth or the different varieties—the trees usually being smaller and of more compact habit as altitude increases, some varieties have an erect, and some a spreading habit—but it will range from 10 to 30 feet.

The first pruning should consist of removing all weaker branches which happen to cross each other closely, and the branchlets (smaller branches) to such an extent as to leave the principal branches free of each other, and, as much as possible, radiating regularly from the centre of the tree.

The smaller of the principal branches should also be removed where they are crowded; and in larger trees, all branches which have a downward tendency, so that a regular canopy of branch and foliage may be formed overhead, supported on fruitful column-like stems. The growth of every tree over four or five years old will be at least two feet in the spread all round in one year, until the full dimensions are reached.

The best months for pruning in the West Indies are March and April, but pruning of large branches may be done in August and September, should the branches have no young fruit to sacrifice. The model form of a cacao tree, and which should always be kept in view by the grower—either with regard to trees to be renovated or young plants—is this; a straight single stem up to three feet

from the ground, and dividing into two or three as it grows higher; each of these again dividing into two or three branches, make up the framework or principal branches which terminate numerously in the leafy branchlets regularly disposed into a well-formed head. The tree uninterfered with from the beginning will assume to itself more or less accurately this mode of growth—termed trichotomous by botanists—which, being innate with it, the model is of very easy attainment, and ensures the greatest possible production of fruit in the least possible space.

The cacao tree is a deep rooter, and therefore soils of the second class, and those of the valleys—especially where they are much broken—are best suited to it.

Aspect is a most important consideration in the culture of cacao in all countries, and it does not thrive in valleys of easterly and northerly aspect. In Trinidad the quality of the produce is modified by various modes of treatment when prepared for the market.

The best quality, irrespective of treatment, is produced by the Criollo cacao of the Spanish inhabitants, who almost monopolise this cultivation, and it is getting scarce. The pods are smaller than those of the better varieties of other kinds, but the seeds are thicker, shorter, and almost globular. The interior of the seed is of a pale crimson, toning down into pink, and the taste slightly bitter.

The Forastero kinds are here much prized; there is the Cundeamar of two kinds, one with yellow, the other with red pods. The former are sooner fit for drying; it has the largest seeds, which are easily fermented and prepared. They are of a pale crimson, approaching the Criollo.

The Amelonado comes next, and then the Calabacillo, which is the lowest kind; its seeds are small and very bitter, and the crimson pigment is so dark that it is very easily distinguished from the other varieties by this mark alone.

The fruit after being picked is either left under the trees in large heaps unopened, or opened at once and brought to the fermenting and drying houses. In the former case a sort of fermentation begins in the fruit, and some planters consider it a good process. The pulp surrounding the seeds contains abundance of saccharine, which causes or rather feeds the fermentation. In many establishments the seeds are fermented in barrels, in others they are merely heaped in a close room. According to the quantity of seeds the planter wishes to obtain, and according to the quality of the seed, this fermentation is continued from three to ten days. The best Forastero cacaos require less time than the other qualities, but more than the Criollo, which completes the process in three days.

The influence of the fermentation is twofold; first, it destroys the pulp which surrounds the seeds and the saccharine matter, which would interfere with the drying process; and, further, it produces a sort of sweetness and flavour in the seed, accompanied by a change from violet to brownish-red or cinnamon colour.

Some hold that fermentation lessens the bitterness of the berry, but on this point doubts are admissible. Cacao must of course be fermented to prepare it for drying, but the process is attended with some risk in wet weather, when the berries are prone to blister.

Not very many years ago fine red cacao, that is cacao having a very clear skin of a reddish colour, fetched the highest price in the English market, and no attention was paid to the flavour of the kernel. The opinions of buyers have since changed, and the samples that now fetch the highest prices are all highly fermented. Red cacao is, however, still in favour, probably on account of the small percentage the manufacturer loses when the berry is clean. Trinidad manufacturers and consumers prefer the light-brown kernel, irrespective of the colour of the skin. The substance of the kernel itself is not changed by fermentation; the starch is left intact, and suffers no loss in weight. A great deal depends upon the weather for curing the cacao for shipment.

The Criollo red-skinned cacao, abundant in Caracas, requires but little fermentation, as it is naturally of a much finer flavour, but its produce is small, and the tree is said to be a slow bearer, and easily destroyed by disease or bad weather.

Jamaica is reviving her long-abandoned cacao cultivation, and Dominica will do well to follow her example, having rich soil in sheltered dells, well adapted, to all appearance, to favour this delicate plant. But the islands to the north of Trinidad must take into their calculation a risk from which that island and Grenada are almost free—that of hurricane blasts. The quality of Trinidad cacao maintains its reputation.

Exports from Trinidad.—In Trinidad cacao is now the principal staple of production (valued at 590,000*l.*, and exceeding the sugar crop), although the annual yield necessarily fluctuates, according to weather and favourable seasons, yet it will be seen the shipments have trebled in the last quarter of a century.

Taking decennial periods the shipments have been as follows :

				Lbs.					Lbs.
1821	..	..	..	1,214,093	1881	..	..	..	11,473,737
1831	..	..	..	1,888,852	1882	..	..	..	12,240,491
1841	..	..	..	2,493,302	1883	..	..	..	12,830,348
1851	..	..	..	5,552,437	1884	..	..	..	14,669,356
1861	..	..	..	6,530,906	1885	..	..	..	14,904,830
1871	..	..	..	6,422,038	1886	..	..	..	19,798,856

Cacao is prepared in two different ways, according to the market for which it is intended. If for Europe, the seeds are covered with dry leaves and a light layer of earth, and left for six or eight days to ferment. Treated thus they lose much water, and their very bitter and astringent principle. The seeds become lighter, of an agreeable and mild flavour, are of a handsome cinnamon colour, and the husk or envelope separates easily from the bean by a slight pressure between the fingers. It is in this condition that the seeds are most sought after, and make the best chocolate. To England, where cacao is principally consumed in infusion, it is sent without any preparation. The seeds are then

of a red colour, their envelope is clean, smooth, adhering to the interior almond, which is of a purple colour, with an astringent and bitter flavour. In this condition it is quite unfit to be manufactured into chocolate. According to Mr. H. Prestoe, colonial botanist, the chief object in claying the beans is to preserve them, but in the French market there is a decided preference for clayed kinds, without apparently much regard being paid to the quality of the interior. The qualities characteristic of the best cacaos are these: A clean reddish-brown or "chocolate" coloured interior. Dryness, so as to render the bean crisp all through, and the "nibs" or plates of the kernel readily separable from each other, and from the shell or skin. The colour of the "nibs" outside is a dull purplish, slightly brown. The fracture presents a fine glaucous purple-brown. Chewed, the nibs reduce and dissolve in the mouth readily, and the flavour is a fine full chocolate, slightly warm and astringent. The consistence is much like that of finely-prepared dessert "ground nuts." There should be no trace of mildew. The process of fermenting consists in collecting the seeds, when taken from the husks or pods, into barrels or troughs, or into heaps, nicely covered with plantain leaves or sacks, within the curing house for two, three, or four days; the house, meantime, being kept closed.

The first object in fermenting is to reduce the mucous covering of the seeds, and the second is to tone the colour of the kernel to a fine purple-brown. On being removed from the fermenting process, the beans are well rubbed with a small quantity of a fine red earth, and then spread out evenly to dry. The beans have to be frequently stirred about in drying, but a very hot sun is avoided during this part of the operation. The whole process is very simple, but it requires considerable practice to produce the desired effect of the fermentation with nicety. The drying or curing house consists of a strongly-built span roof, fixed with wheels running on iron rails, laid along a stout framework, which supports a strong platform underneath, and upon which the beans are manipulated and dried. The gathering of the cacao pods is accomplished by means of an instrument called a "cacao hook," and upon the proper use of which the goodness of the future crop very largely depends. It is most essential that in removing the pod by a clean cut through its stem, its base or the part of the stem or branch from which it proceeds, be not cut also; as at that point other flowers and fruits develop, and therefore it should not be damaged. The pods of the cacao being very persistent, to remove them by pulling is not only laborious, but it tears the fruitful portion of the bark situated immediately at its base, and thus prevents fruitfulness.

Other West Indian Islands.—In 1649 only one cacao tree was known in the Windward Islands, planted for curiosity in the garden of an Englishman at St. Croix.

Dominica.—The cultivation of cacao in Dominica, although long established, dating from some forty years back, is yet in its infancy as regards proper and systematic culture.

The trees have been planted so close, from two to four feet, that, being overcrowded to excess, they are killing each other in the struggle for light and air before they are large enough to bear fruit. There does not appear to have been any attempt at thinning or pruning, or clearing the ground, since they were planted. In 1838, 2354 lb. of cacao were exported; in 1842 it had risen to 19,264 lb. It then fluctuated between 30,000 and 100,000 lb; and the shipments in the last few years have been about 200,000 lb.

This is wholly shipped to Martinique and Barbados, either for partial consumption in those places, or for shipment to England, France, or America. The process of preparing the cacao beans for the market by fermentation, and subsequent claying, seems scarcely to have been heard of in Dominica; but it should be known by all growers that this process, properly performed, raises the value of the article from 20 to 30 per cent.

Haiti exported in 1873 2,783,308 lb., and in 1882, 3,382,192 lb.

Jamaica.—Many years ago, Long, the historian, made the following remarks with regard to cacao: "This tree once grew so plentifully in Jamaica, that the inhabitants flattered themselves it would become the source of inexhaustible wealth to them. In 1671 there were 45 walks in bearing and many new ones in cultivation, but some years afterwards they were all destroyed at once, as it is said by a blast which shook the whole island, so that they were never afterwards recovered, and at the present time are but few."

The number of cacao plantations is now about ten, but several smaller ones are being established, and it is hoped shortly to find Jamaica cacao in the London market in large quantities.

In the seventeenth century cacao was very generally grown in Jamaica, and was of great importance among the exports. But it declined on account of hurricanes and of the excessive duties imposed upon it in England, amounting to 80 per cent. of the value.

The culture has now been resumed and 30,000 plants of the best Trinidad varieties distributed among the planters, and when these have fruited there will be a supply of seeds available for thoroughly establishing the most valuable kinds on the island.

Twenty years ago the only trees in the island were a few inferior kinds scattered here and there in settlers' gardens. In 1867 the quantity of cacao exported was 133 cwt., but ten years after it had reached 375 cwt., of the value of 1051*l.*, and in 1870 644 cwt. Now the quantity exported exceeds 4000 cwt., and it is ranked equal to high-class Trinidad. The shipments in 1884 were 4016 cwt., valued at 8997*l.*, and in 1881 3855 cwt.

As concerns temperature and rainfall, some of the plains and valleys of Jamaica are admirably adapted for the cultivation of cacao. Although the island is about $7\frac{1}{2}$ degrees further north than Trinidad, and nearly six degrees further north than Grenada, it is almost in the same latitude as some of the best cacao districts of Mexico and Guatemala.

The situations best suited, however, for successful cultivation are the moist valleys and hollows up to 500 feet, well protected from winds. The rainfall should not be below an average of 60 inches per annum, nor the mean annual temperature below 75° Fahr., and the soil should be deep and moderately rich, the preference being given to that containing a certain proportion of marl or lime.

In *St. Lucia* there are about 500 acres under culture with cacao, but the annual exports are almost stationary at 300,000 lbs. A little is grown in Montserrat.

In *Grenada* there are at least 4000 acres planted with cacao.

In the quality of its cacao, which may be called the staple of the island, Grenada stands next to Trinidad, and may with care soon have a name for its cacao-nibs as well as its larger rival. Probably some of the cacao exported from Grenada at this time is not inferior to the best Trinidad, though its price is from ten to twelve shillings a hundredweight lower, but the mass of the seeds are cured by peasant proprietors in a crude manner, which renders the article inferior in the market, and the majority of the production gives the name to the rest.

The shipments were in—

				Lbs.					Lbs.
1865	..	..	..	1,263,743	|	1875	..	..	3,137,360
1870	..	..	..	2,500,000	|	1885	..	..	5,500,000

Mr. Douglas Alexander furnishes the following observations relative to the management and practice in that island:—

“The cacao-tree is on the whole a hardy one, but care is necessary in selecting a proper site for planting. It will not thrive if exposed to the direct influence of the sea breeze nor in any bleak locality. It therefore follows that sheltered plains or valleys and hill-sides with a westerly or southerly aspect are most suitable for its growth. If strong breezes are prevalent, it is necessary to plant rows to windward so as to shelter the trees from their deleterious influences. Breadfruit, breadnut, figs and mammee sapotas will form good shelter trees for this purpose. The most esteemed shade-tree in Trinidad is the ‘bois immortelle’ (*Erythrina umbrosa*).

“In lower lands it is often necessary, especially where the soil is dry, to plant shade-trees throughout the pieces to protect the cacao from the sun’s rays, but all sorts of hard woods should be shunned. In the mountains shade-trees are unnecessary, as it is not advisable in damp localities to exclude the rays of the sun.

“Drainage is necessary, as the trees will not thrive if stagnant water is permitted to lodge near the roots. It is usual to plant from three to four seeds in each hole, the holes being from 11 to 15 feet apart, according to the lie of the land and the nature of the soil. On a hillside, 11 feet apart on the descending line will often be found sufficiently wide, although a greater distance will be found necessary in the lateral line. In flat or rich land from 14 to 15 feet square is not too far distant. Plantain or fig-trees are put in

close alongside of the cacao seeds. These grow up and form a good shelter for the young trees, and, besides, give out moisture from the roots, which is very beneficial to the growth of the young cacao. Besides these, other smaller esculents may be profitably planted, such as sweet potatoes (*Batatas edulis*), tannias, yams and manioc. These help to create a shade and keep the land cool, besides giving the cultivators some remuneration for the labour and expense of bringing on the young cacao.

"When the trees are about a year old, all must be removed from the hole excepting one, which should be allowed to remain. Naturally, the best of the plants will be selected for this purpose.

"The period at which some fruit may be expected from the trees varies from three to six or seven years, according to the soil and aspect; but it is usual to remove the first year's blossoms, so as to give strength to the plant and increase the subsequent yield.

"In the lower lands the best months for planting are from the middle of April to the middle of June, and from the middle of September to the middle of November. In the upper lands the seeds may be planted all through the year, except during the latter half of July and August, when the heat is too great. At all times, however, it is better to avoid planting at or near the full moon.

"The tree ought to be a single stem of from four to five feet high, and then branching off into three or four branches. No suckers should be allowed to grow, and all superfluous wood must be pruned off carefully. The best months for pruning are April and May, but solitary suckers should be removed as often as possible, except at the full of the moon, when the sap is up in the branches."

French West Indies.—In 1655 the native Caribs showed to M. de Parquet trees of the cacao, growing wild in the woods of Martinique. A Jew named Benjamin first began to cultivate the trees; but it was not till about twenty-five years after that any great progress was made in the culture.

In 1727, owing to some disease, the whole of the cacao trees perished in Martinique; the inhabitants, half ruined, after having tried several remedies, resolved at last to plant coffee. Of late years the cultivation of cacao has however been resumed and greatly extended in Martinique, and the quality is much esteemed. There are now 286 planters, with 500 acres under culture.

The culture of cacao, which had long been neglected in Guadeloupe and its dependencies, is again coming into favour. The plantations are formed from plants imported direct from Caracas. There are 230 plantations with 2800 acres under cacao.

The land under culture and the production of cacao in the four French colonies in 1870 and 1886 were as follows:—

	1870.		1886.	
	Hectares of 2½ Acres.	Kilogrammes of 2½ lbs.	Hectares of 2½ Acres.	Kilogrammes of 2½ lbs.
Martinique	628	262,300	939	437,606
Guadaloupe	463	125,131	1,094	257,877
French Guiana	255	54,556	245	25,000
Reunion	21	3,750	33	2,125
	1,367	445,737	2,311	722,608

British Guiana.—Attention is being given to the planting of cacao on the vegetable soils to the rear of the cane groves. The cacao estates are chiefly on Canal No. 1, west bank of the Demerara River, and cacao is grown on a small scale on some sugar estates at the back of the cane plantations.

The cacao of French Guiana, dried in the sun or by a current of air, presents unctuous qualities, which render it sought for to mix with the perfumed but drier kinds grown in Caracas. The export in 1874 from French Guiana was 66,000 kilos.; there are now 245 hectares under culture by 44 planters, and the export is only 25,000 kilos., which is not half the produce in 1836 from 197 hectares.

The exports of cacao from Surinam have been as follows:—

	Kilogrammes.		Kilogrammes.
1879	1,122,990	1882	1,237,707
1880	939,899	1883	1,765,174
1881	1,670,053		

A little cacao is grown in the Mauritius. Some small quantity is still produced in Reunion, of a good quality, the Caracas sort. Cacao used to be grown in the island in connection with coffee.

Production in Venezuela.—Venezuelan, or, as it is generally termed, Caracas cacao, has ever been considered the best of all that is produced upon the American soil. Although it was from Mexico that the bean was first imported into Spain, large quantities of it were subsequently exported from the Venezuelan port of Maracaibo to the Mexican port of Vera Cruz. The cacao tree flourishes best when planted in a damp, level soil, and begins to produce fruit when about five or six years old, its yield being usually about one pound at that age; it does not, however, attain its full bearing capability until it has attained its eighth year, at least in the neighbourhood of the sea coast; and in some places, such as the Guique districts upon the lake of Valencia, in the neighbouring province of Carabobo, it does not attain its full yielding power until it has reached its ninth year. Experienced planters residing in the capital (Caracas), however, state that, with proper care, it may be made to cover the expenses of its cultivation from its sixth year.

The regular periods for gathering in the crops are in June and

December, denominated the "crop of St. John" and "Christmas crop;" but, when the plants have attained maturity, the gathering of scattered pods is carried on almost daily.

The production of cacao has not only greatly diminished in Venezuela, owing to the perpetual civil warfare prevailing, but its quality has materially deteriorated owing to the introduction into the country of seed, commonly termed "Trinitario," from the island of Trinidad, which, although infinitely more prolific than the native seed, produces a bean somewhat bitter in taste, and very inferior, as regards essential oil and richness of flavour, to that produced from the latter. The difference between the two can indeed be detected at once by the most casual observer, and the scale of prices at once confirms it.

Ineffectual efforts were made to guard against the deterioration of the native cacao, enjoying so high a reputation in foreign countries, by the introduction of the Trinidad seed, to the extent of a proposition being made by the Minister of the Interior and Justice to the Congress in the year 1850, that any person detected in introducing the same into the eastern ports of the Republic in constant communication with the island of Trinidad should be subjected to corporal chastisement.

The Trinitario cacao is a more robust tree than the Criollo, the fruit pod is larger and more variegated, the seeds are smaller and flatter, and the taste more astringent. It is cultivated chiefly in the eastern part of the Republic, and the product is known as Cacao Barlovento. The Criollo kind is grown chiefly in the western section, especially in the States of Carabobo and Lara. The Trinitario seed is, at the present time, the staple of cacao from the districts of Güiria, Maturin, Carúpano, and down the eastward or windward coast as far as the Rio Chica; but the native or genuine "Creole" plant is still cultivated upon some few estates. The Trinitario seed is also sown to some extent in the valleys of the Tuy, near the capital, although the majority of the estates there are sown with Creole seed, and thus good cacao can still be procured from thence. From the port of La Guayra, running westward towards Puerto Cabello, and particularly at Choroni, Ocumare, Turiamo, Patanemo, and Borburato, lie the districts where the best Venezuelan cacao is now produced; and the choicest of all at an estate called Chuao, near Choroni, the property of the University of Caraccas. From the neighbourhood of San Felipe, the capital of the State of Yaracuy, a very superior unmixed cacao is sent to Puerto Cabello, to the amount, including a small quantity from Barquisimeto, of about 4000 to 6000 fanegas annually. The other kinds are Maracaibo, Rio Chica, and Rio Cariba or Carúpano. The Spanish fanega, the general weight employed, is about 50 kilos.

From what has been above stated, it will be seen that it is from Cape Codera down to Puerto Cabello, following the coast-line, that the Caracas cacao is principally cultivated; and on some estates on this line, where the Trinidad seed had been introduced, it has fallen into great disrepute, and some of the planters even

import the red soil of Choroni, in order to impart a better colouring to their bean.

In the period from 1830 to 1855 the minimum export was in the year 1834-35, 4,243,320 lbs., and the maximum in 1851-52, 10,922,926 lbs.

In 1881-82 the export was 5,259,744 kilos., of which 3,403,761 went to France, 200,818 to Germany, 76,727 to England, 135,200 to the United States, and 802,690 to Spain, and 640,548 kilos. to other countries. In 1882-83 the total export was 6,498,229 kilos.

In 1884 there were 55,000 acres under culture with cacao. As there were 1,304,025 kilos. consumed locally in 1882-83, the total production was 7,802,254 kilos., or 313 kilos. per hectare of $2\frac{1}{2}$ acres.

The exports of cacao from the port of La Guayra in the year ending 1884 were 3,270,943 kilos., of which 2,121,300 went to France, 592,455 to Spain, 293,746 to Germany, and 191,721 to New York.

Venezuela exported in 1883, 6,498,229 kilos. Venezuelan cacao is generally dearer than other kinds, and is in great request.

The high-quality cacao (which is almost entirely absorbed by the Spanish and French markets, whilst the inferior qualities go to England and Germany) is produced almost exclusively in the coast districts, being thus commonly termed "cacao de la costa"; the seed within the pod, of a rich dark-brown colour, being larger, richer, and of a more oily quality than that produced anywhere inland; the "cacao mezclado," or mixed cacao, is that grown upon estates where such of the original first-class "criollo cacao" trees as may have died out have been replaced by others raised from Trinidad seed; such amalgamation somewhat depreciates the quality of the produce, notwithstanding that a decided improvement in the quality of the Trinidad seed has been attained in some districts, owing to the favourable nature of the soil. This Trinidad cacao came into favour some years ago on account of the more robust nature and greater productiveness of the plants, but is now universally held to be of an inferior quality.

Ecuador.—This is the largest producing South American State. The crop varies, the highest export having been 25,000 cwts., but of late has been rather on the decline. The exports have been as follows:—

				Cwts.					Cwts.
1857	..	..	..	149,624	|	1873	..	..	251,812
1863	..	..	..	147,722	|	1883	..	..	168,600

British Honduras.—Mr. D. Morris, in his work on British Honduras, states that one if not more species of the cacao plant is a native of that colony.

"In the forests along the banks of the Rio Grande and in the neighbourhood of the Toledo Settlement, and again in the forests on the western frontier, near the upper portions of the Beleze River, cacao trees are found wild in the woods with their stems covered with flowers and often loaded with fruit. The trees which came under my notice in the south were probably forms of

the same species (*T. Cacao*) which yield the best kinds of Trinidad cacao; but in other instances the characters approached more nearly to *T. angustifolia*, which is supposed to be a distinct species and under cultivation in Guatemala.

"This last is no doubt the Tabasco cacao of the Atlantic slopes of Central America, which is probably the celebrated Soconusco cacao of the Pacific slopes. The wild trees in the forest grow under the shade of large overhanging trees in deep soil and in rather moist situations. That cacao trees, even under cultivation in the plains, require permanent shade is very clearly indicated by the circumstances under which the wild trees are found. The cacao tree never appears to such advantage or thrives so luxuriously as when it occupies a cool, moist situation in deep, well-drained soil, thoroughly sheltered from strong winds, and with moderate shade above. The Soconusco cacao, grown in the province of that name on the Pacific, is supposed to be the best cacao known, and little, if any of it, finds its way into foreign markets.

"This cacao is supposed to have been reserved, from time immemorial, for the use of the Royal Court at Mexico; and the drink or beverage prepared from it was highly appreciated by the Mexicans, with whom it was held in religious veneration. As the trees have the same habit and characteristics as those of Caracas cacao, derived from the class of *cacao criollo*, the trees in British Honduras will no doubt be found to be the yellow-fruited variety of that highly-esteemed plant. In Forastero cacao (the class of cacao chiefly under culture in Trinidad and Grenada), the yellow varieties are supposed to yield finer and better cacao than the red; and if these characteristics obtain in the *cacao criollo* class, then we have in the Tabasco or Soconusco cacao of Central America, which, as shown above, is also a native of British Honduras, the finest quality of cacao which can be grown.

"In the woods the fruits are smaller, probably, than they would be if the trees were under cultivation; but if any difficulty were experienced in obtaining sufficient quantities of seed in British Honduras, they might be obtained from Guatemala or from Tabasco, or any districts on the mainland known to possess this particular variety."

Cacao, besides being cultivated in all the gardens of Moyobamba, the eastern territory of Peru or the Montana, grows spontaneously, and is met with in abundance and of various kinds in the woods of the province.

Production in Brazil.—The culture of cacao was first begun in Bahia in 1780, plants being brought from Para, where it is indigenous to the districts of Valencia, Camanù, and Ilheos. The culture has steadily increased.

The total shipments of cacao from Brazil have been as follows:—

	Lbs.		Lbs.
1830	57,316	1871	10,180,242
1841	4,455,068	1881	11,726,000
1851	8,405,440	1882	11,726,000
1861	8,671,188		

All this goes to Europe. The quantity exported is subject to great fluctuations owing to the frequent overflows of the river Amazon, which stops the gathering of the fruit.

The tree is indigenous in Para, being found in great abundance on the banks of the large rivers of that province, and from Para comes five-sixths of the exports of Brazil. It is, besides, grown to some extent in Bahia, and in small quantities in Maranhao and in Rio Janeiro; requiring but little labour and capital, it is well worthy of more attention.

At the end of three years the tree is well grown and begins to produce fruit. These are ripe about June and December, and are knocked off the trees with the aid of long forks. They are then piled in heaps on the ground or under shade, and allowed to ferment for three or four days, after which they are cut open and the beans or seeds removed, which are spread on the ground or on mats to dry. The tree flourishes well on the banks of the rivers Madeira and Salimoes. There are two harvests yearly, the first in December and January, the second, which is the most abundant, in May and June. The tree, whether in its wild or cultivated state, is not injured by the overflowing of the rivers, even when the trunk is deeply submerged during the inundations. In the provinces of Amazonas and Para it grows naturally without culture, and the trees produce freely, requiring no care except the collection of the fruit, which in those localities forms the fortune of the daughters of the cultivators.

The principal part of the cacao shipped is exported from the valley of the Amazon and the banks of the Tocantins. It is in the provinces of Bahia and Ceara that cacao is most largely developed year by year. It grows spontaneously and abundantly in the forests of the Amazon, and is largely cultivated in Parana.

In the ten years ending 1862 the shipments of cacao from Para averaged 6,700,000 lbs. per annum.

Though in many cases carelessly cultivated, it grows for the most part spontaneously. The tree with moderate care will continue to give two crops annually for fifty or sixty years. The towns in this province which send cacao for shipment to the capital are Cameta, Gurupa, Obidos, and Santarem; nearly all goes to France.

Culture in the East.—The experiments on the cultivation of the cacao tree on the Nilghiri Hills is still a subject of attention with the Government of India. It is some years since a large number of the young trees were introduced into the Budliar Gardens, and their cultivation was so far a success that about four years ago two cases of seedlings from the gardens were sent as specimens to Calcutta. The Government recently inquired whether seedlings of another species would not be acceptable, and a case of the new variety was to arrive by one of the ships daily expected at Calcutta, it being the desire of the Government that the seedlings should be planted in the Budliar Gardens, where the results of the first experiment had been so satisfactory.

Ceylon.—Attention has recently been directed to the cultivation

of cacao in this island, and has met with much success. The districts of Dumbera, Kurunegala, Moneragala, Dolosbagie and Matale show how this now fully recognized product is being gradually extended. The acreage in cultivation is 4746 acres growing by itself, and 10,709 acres amongst coffee. As with tea, this area is steadily increasing. The exports for the six years tabulated were as follows:—

1879	..	..	..	42 cwt.,	valued at Rs.	1,820
1880	..	..	..	121 "	" "	5,445
1881	..	..	..	283 "	" "	12,735
1882	..	..	..	864 "	" "	38,880
1883	..	..	..	3,588 "	" "	161,360
1884	..	..	..	9,241 "	" "	"

These figures, showing the produce of cacao only in very partial bearing, prove how rapidly the cultivation is increasing. One of the greatest authorities upon this cultivation (Mr. Theuser of British Guiana) states that the cacao tree generally begins to bear in its fourth, and is considered to attain maturity at its twelfth year. Ceylon cacao has so far been able to command the highest prices in the London market.

Cacao has within recent years been introduced into India, and is now being cultivated commercially in some parts of the Madras Presidency. It is grown in Java, Timor, and the Moluccas.

The cacao tree was introduced into Celebes by the Spaniards between 1560 and 1570. About 1500 piculs were produced in 1854, and since then the production has greatly increased; the yield there is about 5 or 6 lbs. per tree.

The exports of cacao from Netherland-India by private cultivators have been as follows:—

								Kilos.
1875	..	..	..	..	..	..	..	202,654
1880	..	..	..	..	..	..	..	146,504
1885	..	..	..	..	..	..	..	115,894

Culture in the Philippines.—The cacao tree was first imported into the Philippines from Acapulco—either, according to Camarines, by a pilot called Pedro Brabo de Lagunas, in 1670, or, according to Samar, by some Jesuits during Salcédos' government, between 1663 and 1668. Since then it has spread over the greater part of the island, and although it is not cultivated with any excessive care, its fruit is of an excellent quality. This cacao of Albáy, if its cheapness be taken into consideration, may be regarded at least equal to that of Caracas, so much prized in Europe, and which, on account of its high price, is generally largely mixed with inferior kinds. The trees are usually found in small gardens close to the houses; but so great is the laziness of the Indians that they frequently allow the berries to decay, although the native cacao sells for a higher price than that imported.

At Cebu and Negros a little more attention is paid to its cultivation; but it does not suffice to supply the wants of the colony which imports the deficiency from Ternate and Mindanáo. The

best cacao of the Philippines is produced in the small island of Maripipi, which lies to the north-west of Leyt ; and it is difficult to obtain, the entire crop generally being long bespoken. The Indians usually cover the kernels just as they are beginning to sprout with a little earth, and placing them in a spirally rolled leaf, hang them up beneath the roof of their dwellings till required for planting. They grow very rapidly, and to prevent their being choked by weeds are planted out at very short distances. This method of treatment is probably the reason that the cacao trees in the Philippines never attain a greater height than eight or ten feet, while in their native soil they frequently reach thirty, and sometimes even forty feet. The tree begins to bear fruit in its third or fourth year, and in its fifth or sixth it reaches maturity, when it usually yields a "ganta"—three quarts—of cacao seeds.

The profits arising from a large plantation would therefore be considerable, yet it is very rare to meet with one. The great obstacles in the way of large plantations are the heavy storms which recur almost regularly every year, and often destroy an entire plantation in a single day. In 1856 a hurricane visited the island just before the harvest, and completely tore up several large plantations by the roots; these catastrophes naturally caused much discouragement to the cultivators.

Travellers in America say that a well-kept cacao plantation is a very picturesque sight. In the Philippines, however, or at any rate in East Luzon, the closely-packed, lifeless-looking, moss-covered trees present a dreary spectacle. Their existence is a brief one. Their oval leaves, sometimes nearly a foot long, droop singly from the twigs, and form no luxuriant masses of foliage. Their blossoms are very insignificant; they are of a reddish yellow, no larger than the flowers of the lime, and grow separately on long weedy stalks. The fruit ripens in six months. When it is matured it is of either a red or a yellow tint, and is somewhat like a very large, rough gherkin. Only two varieties appear to be cultivated in the Philippines, although eighteen kinds are spoken of.

On the Segaliud river, North Borneo, there were two or three groves planted by the natives long ago, which thrived admirably and bore freely. A small European plantation of cacao on the Sibooaga was doing remarkably well, commencing to fruit, when circumstances led to its being abandoned; even after this they continued to bear. The vigour and size both of the trees and fruit at Segaliud lead to the hope that cacao will be one of the main products of North Borneo if properly tried on good soil.

According to F. Engel, a flourishing cacao plantation requires less outlay and trouble, and yields more profit than any other tropical plant, yet its harvests, which do not yield anything for the first five or six years, are very uncertain, owing to the numerous insects which attack the plants. In short, cacao plantations are only suited to large capitalists, or to very small cultivators who grow the trees in their own gardens.

GUARANA.

A product, allied to cacao in some respects, may be incidentally mentioned here, made from the crushed nuclei of the seeds of a Brazilian plant, and highly esteemed there, although it has not appeared much in European commerce. This is guarana, the product of a climbing shrub, the *Paullinia sorbilis*, Mart., belonging to the order *Sapindaceæ*. The tree grows abundantly in the province of Amazonas, along the banks of the Tapagos, Rio Negro, &c., as well as in Guiana and Venezuela. The genus indeed is a large one, and it is probable that the seeds of *P. Cupana* of the Orinoco and many other species are used for a like purpose.

It is manufactured by the Muras, Mondrucas, and other tribes of Indians. The fruit, scarcely as large as a walnut, contains five or six seeds; it is gathered when ripe and roasted intact. The seeds are then taken out, and, after being pounded in a heated mortar, are formed into a thick paste with water, and moulded into cakes, fanciful shapes or cylindrical rolls, something like a large sausage, and then finally dried in the sun or by the fire, when it becomes extremely solid and difficult to fracture. In this form it will keep good for any length of time, and is always ready when required.

Guarana is used extensively in Brazil, Guatemala, Costa Rica, and other parts of South America as a nervous stimulant and restorative for sick headache, but sometimes purges violently. It is included in the French Pharmaceutical Codex, and also among the non-official substances of the United States Dispensatory. Besides its medicinal properties, this substance has a reputation for affording a refreshing beverage, similar in its effects to tea and coffee. Grated down, it is very like powdered cocoa in appearance. Two spoonfuls of the powder, mixed in a tumbler of water, is regarded as a stimulant to the nerves, and, like strong tea or coffee, is said to take away the disposition to sleep.

The active principle is an alkaloid, first discovered by Von Martius, and called by him guaranine, but since shown by Dr. Stenhouse to be identical with theine. Guarana contains more than double as much of this alkaloid as good black tea, and five times as much as coffee; the proportions being 5.07 per cent. in guarana, 2.13 per cent. in tea, and about 1 per cent. in coffee.

The same alkaloid is found to the amount of 1.25 per cent. in maté or Paraguay tea, the produce of several species of *Ilex*. It is rather a singular coincidence that the same alkaloid should prevail in all the principal substances employed in a similar manner as beverages in different parts of the world.

In addition to theine, guarana contains a colouring matter apparently analogous to the tannin in cinchona bark, and also a fatty matter, which, like cacao butter, does not appear to become rancid by keeping. The Indians of Brazil stain their faces with the colouring matter.

There is exported annually from the city of Santarem about 16,000 lbs. of guarana, valued at 8*d.* or 9*d.* per pound; near the Rio Negro it sells for very much less, but on the continent of Europe it has been sold occasionally, for its alleged medicinal properties, at almost fabulous prices.

KOLA NUTS.

The Cola or Kola nut-tree (*Sterculia acuminata*), whose habitat is all along the West African coast, from 10° N. lat. to 5° S. lat., is much prized by the natives. In Senegal 66,000 lbs. of the nuts are consumed; they are there known under the name of Goureaux or Gero nuts, and on the Congo as Makasso. It is met with at Sierra Leone, Liberia, the Gold Coast, the Niger, Fernando Po, St. Thomas' and Princes' Islands, Gaboon, Congo, and the Portuguese Possessions. About 600,000 lbs. are imported annually to the Gambia; Sierra Leone exports about 3500 baskets or packages yearly, valued at £35,000 to £40,000. There is an export duty of 5*s.* per cwt. on it at Sierra Leone. The properties of the nut are said to be twofold. In the first place, like olives, it enhances to many palates the flavour of food eaten afterwards; secondly, it possesses the more important function of staying the cravings of hunger, and enabling those indulging in it to endure prolonged labour without fatigue. The fresh nuts have a bitter taste. It appears in that part of the world to satisfy the general craving of mankind for a stimulant. The trade is extending into Central Africa, and northward to the African shores of the Mediterranean, indicating an increased demand. It constitutes an important article in the Soudan. They are said to contain more theine (viz., 2·34) than most of the other dietetic products. Infusions of coffee, tea, yerba maté or guarana are used as beverages by three-fourths of the human race, and each contains this active principle.

Thus does chemistry reveal the true reason why the unerring instinct of man, even in his savage state, has led him to select from the many thousands of plants presented to him in nature, just four or five with which to concoct a beverage that would seem to be a necessary, rather than a luxury of life. The nuts have to be kept moist, for if they become dry and shrivelled they lose not only their mercantile demand, but a considerable portion of their bitterness. These so-valued luxuries are offered to visitors as a substitute for coffee, being handed round on salvers, hence the frequent application of the name, "the coffee of the blacks," or of Soudan, bestowed on them. One remarkable feature worthy of mention is the marked avidity displayed by the negro inhabitants of Sierra Leone and the Portuguese colonies for the nuts in preference to the beverages of tea and coffee, although each contains the same elementary alkaloid. In countries where slaves were at one time imported, the culture of the tree was introduced to supply the demand. Hence the introduction of the tree into the

Mauritius, several of the West India islands, Brazil, Mexico, and other extensive regions on the continent of America.

This interesting plant is being largely cultivated in Jamaica in the hope that the nuts may become a recognised article of commerce. The tree is hardy and easily established, and there would be no difficulty in supplying large quantities of the nuts every year. Locally in the island the nuts are used as a stomachic and a tonic. They are said to have effected very remarkable cures in dyspepsia and allied disorders, and are used for this purpose in the same manner as cacao or chocolate. It is prepared by grinding the dry cured nut into a powder and mixing with boiling water, sugar and milk. Some people use kola nut regularly at breakfast in this manner, and consider it superior to everything else of the kind.

To cure the nuts for export they only require to be taken out of the pods and subjected to careful drying in the sun until quite firm and hard. The process, however, requires to be thoroughly done, owing to the thickness of the cotyledons and to prevent mouldiness on the voyage.

There is another kola nut, the produce of *Garcinia kola*. The fruit, the size of an apple, contains three or four seeds of a strongly bitter, astringent and aromatic taste, but differing in its properties from the true kola.

COFFEE.

After Tea there is scarcely any other staple of commerce used for dietetic beverages that has made more rapid progress in the world, or gained for itself more general acceptance with all classes, than Coffee. Its constantly increasing consumption as a beverage, as seen in the statistical tables given, clearly proves that it may be regarded not only as one of the necessities of life, but also as a very important one. The continued increase in the demand for coffee, irrespective of climatic influences, will of necessity extend the present area of its cultivation largely into those belts of land which are favourable to the production of the plant. These lands are found lying principally between the isothermal lines of 25° north, and 30° south of the equator. It has been ascertained that the plant cannot be grown to advantage in places where the thermometer descends at any time below 55°.

Besides the existing countries where coffee is cultivated, there are many other places where it might be extensively grown, such, for instance, as the western coast of Africa generally, the interior ranges of Natal, the mountain ranges on the northern coast of Australia, from Moreton Bay to Torres Straits, &c. Soil and climate are the circumstances which chiefly affect its commercial value. The cultivation of coffee is now widely diffused over all tropical parts of the world. It is found in most of the West India Islands, in the provinces of Central America, Guiana,

Mexico, Bolivia, Peru, and especially Brazil, the largest producer of all in the new world. It is widely spread over Arabia, and many parts of the east and west coast of Africa, Southern India, Ceylon, Java, Sumatra, Timor, the Philippines, and other islands of the Eastern Archipelago, Bombay, Madagascar, &c.

The coffee shrub is indigenous to the mountains of South-Western Abyssinia, extending, according to Welwitsch and Peters, to Mozambique and Guinea.

Coffee Production of the World.—Few people have even an approximate idea of the magnitude of the coffee trade of the world; taking the production at present at 13,000,000 cwts. (which is certainly much within the mark), and estimating it at about 60s. per cwt. on the spot, we arrive at a total of £39,000,000. Our imports into the United Kingdom in 1875 of under 1,600,000 cwts. were valued at £7,500,000, and of 955,274 cwts. in 1888 at but £3,585,213.

Let me now trace the aggregate progress of coffee production as shown in the last quarter of a century.

	1861.	1875.	1886.
	cwts.	cwts.	cwts.
Brazil—Rio	3,610,400	7,142,000	4,354,000
„ Santos	359,100		2,591,600
„ Bahia	72,000		187,500
Mexico—Costa Rica and Guatemala	54,200	354,260	..
Laguayra and Porto Cabello, Mara- caibo and Guayaquil	295,000	410,650	1,332,625
Porto Rico, Cuba, and British West Indies	100,200	377,000	203,875
Haiti	314,600	24,500	500,500
Java	1,117,100	1,400,000	1,365,626
Padang	203,900	161,000	104,000
Menado	16,300	20,000	33,375
Sumatra, Macassar, Timor, &c. ..	9,700	35,000	181,000
Ceylon	593,900	967,700	190,000
British India and Manila	173,100	446,420	349,000
Africa, Mocha, &c.	..	..	135,625
	6,919,500	11,338,530	11,528,726

The entire production of coffee in the world may be set down at the following figures in pounds :—

1832	209,000,000	1880	1,320,000,000
1855	660,000,000	1886	1,292,000,000

The following particulars, collected by Messrs. S. Rucker & Co., show the total production and consumption of the world for 1888, and the estimated amount for 1889 :—

PRODUCTION OF THE WORLD.

	1888-89. Tons.	1889-90. Tons.
Brazil—		
Rio	270,000	150,000*
Santos	150,000	90,000*
Bahia, &c. ..	30,000	22,000*
Java, Government	33,800	31,000
„ Private ..	18,000	16,000
Sumatra	7,000	6,500
Macassar	7,200	7,000
Manila	5,700	6,000
Ceylon	6,000	6,000
East Indies ..	13,200	11,600
Mocha and African	6,000	6,000
British West Indies	5,100	6,000
Cuba and Porto Rico	21,000	19,000
St. Domingo ..	27,000	24,000
Costa Rica ..	9,000	9,000
New Granada,		
Venezuela, La		
Guayra, Mara-		
caibo, &c. ..	40,000	42,000
Guatemala, Hon-		
duras, Nicara-		
gua, &c.	36,000	38,000
Mexico	6,000	5,500
	<u>691,000</u>	<u>495,600</u>

CONSUMPTION OF THE
WORLD.

	1888-89. Tons.
United States	232,000
Canada, &c.	18,000
Germany	123,000
Austria and Hungary ..	36,000
France	66,000
Belgium	27,000
Holland	27,000
England	15,000
Denmark	5,700
Norway and Sweden ..	21,000
Russia	16,500
Italy	16,500
Switzerland	7,800
Portugal and Spain ..	6,600
Turkey and Levant ..	14,400
Balkan States	9,000
North Africa	10,500
Cape, Australia, &c. ..	19,500
	<u>671,500</u>

	Tons.
Stock in United States and Europe, August 1, 1888	104,500
Add crops of 1888-89	691,000
	<u>795,500</u>
Deduct total Consumption in the World, 1888-89	671,500
Would leave Stock on August 1, 1889	124,000
Add estimated Crops of 1889-90	495,600
	<u>619,600</u>
Deduct total Consumption in the World for 1889-90, estimated at 100,700 tons less than for the preceding year	570,800
Would leave estimated Stock, August 1, 1890	<u>48,800</u>

In 1874 coffee fetched on the average £5 per cwt., but since then it has gradually declined in price to £3 5s. per cwt.

The following decennial range of prices of coffee are given by Messrs. Travers & Sons, the eminent produce brokers of London:—

	Per lb.		Per lb.
	s. d.	s. d.	s. d.
1787	2 4	to 4 6	
1797	3 5	„ 5 6	
1807	4 4	„ 5 6	
1817	1 10	„ 3 4	
1827	1 1	„ 2 9	
1837	1 3	„ 2 1	
1847	0 10	to 1 10	
1857	1 0 $\frac{1}{4}$	„ 1 6	
1867	0 8	„ 1 9	
1877	0 11	„ 1 7 $\frac{1}{2}$	
1887	1 1 $\frac{1}{2}$	„ 1 7	

Consumption in the United Kingdom.—If we examine closely the statistics of coffee consumption in this country, we find that in

* Most other estimates give the total production of Brazil as only 200,000 tons.

the first four years of the century it was only an ounce per head; in the five years ending 1809 it averaged three ounces; it then increased, in the next quinquennial period, to six ounces, at which proportion it remained steady till 1825-29, when it advanced to eleven ounces; increased in the next five years to fifteen ounces, averaged about a pound per head for the following ten years, and then kept steady at about a pound and a quarter till 1861, since which period it has been gradually declining contemporaneously with the increased consumption of tea, and notwithstanding a reduction of duty.

In the year 1852, with a population of 27,500,000, we consumed 35,000,000 lbs. of coffee, the customs duty in that year being 3*d.* per pound weight; whereas in the year 1887, with a population of 37,000,000, the annual consumption had decreased to a little over 31,100,000 lbs., notwithstanding that the duty had in the meantime been reduced to 1½*d.* per lb. Ten years ago the proportion of coffee consumed per head of the population was 0·99 of a pound, now it has dropped to 0·81.

It has been well observed, that it would be interesting to enquire why it is that Great Britain, which has the lion's share of the carrying trade of the world, and whose intercourse with the East is daily and hourly increasing, whose tropical colonies grow coffee in abundance, and whose opportunities for obtaining good coffee are unequalled, consumes less coffee per head of its population than almost any other civilised country in the world, and this in spite of the enormous increase of its population, and also in spite of the increased demand for non-alcoholic drinks, and the opening of hundreds of so-called coffee-taverns throughout the country. Notwithstanding that the consumption of tea shows some inconsiderable increase, and is undoubtedly the popular English beverage, it is impossible to believe that the use of "coffee," in its generally accepted meaning, is on the decline. The true reason is undoubtedly to be found in the wholesale adulteration to which the genuine article is subjected, and which is systematically encouraged by the Government. More than 116,000 cwts. of foreign chicory are annually imported, besides what is grown at home.

Our imports of chicory were in—

	1885.	1886.
Raw cwts.	116,612	112,467
Roasted lbs.	410,647	442,635
Coffee and chicory mixed „	105,080	135,193

In 1887 we imported 138,090 cwts. of chicory, of which 106,127 cwts. were taken for home consumption, and in 1888 116,059 cwts., of which 100,413 cwts. were taken for consumption.

Chicory pays a duty of 13*s.* 3*d.* per cwt.

The following shows the consumption of coffee in the United Kingdom, and the average quantity consumed by each individual of the population during the last twenty years :—

Year.	Quantity, lbs.	Population of the Kingdom.	Average per Individual.
1867	31,282,023	30,156,000	1.04
1868	30,356,818	30,381,000	1.00
1869	28,839,100	30,611,000	0.94
1870	30,629,710	30,829,000	0.98
1871	31,010,615	31,048,000	0.97
1872	31,650,192	31,836,000	0.98
1873	31,930,928	32,124,000	0.99
1874	31,252,368	32,426,000	0.96
1875	32,048,016	32,737,000	0.98
1876	32,894,400	33,199,994	0.99
1877	32,286,016	33,575,941	0.96
1878	33,329,552	33,943,773	0.97
1879	34,122,032	34,362,557	0.99
1880	31,868,480	34,622,930	0.92
1881	31,207,904	34,952,294	0.89
1882	31,214,512	35,297,114	0.88
1883	31,562,048	35,611,770	0.89
1884	32,255,664	35,961,663	0.90
1885	32,660,320	36,331,119	0.90
1886	31,608,304	36,709,409	0.86
1887	30,052,064	37,091,564	0.81

General Consumption.—Coffee may be said to form almost the exclusive dietetic warm beverage of 100,000,000 of the human race.

The principal countries using it largely, besides Turkey and Egypt, are the United States, Austrian and German Empires, France, Holland, Belgium, Switzerland and the Scandinavian States, and Great Britain. In some of these, as the Zollverein, Belgium, Holland, Norway, Sweden, Denmark, and North America, &c., the consumption is from 7 to 10 lbs. per head.

The Statistical Department of Denmark compiled a statement of the consumption of the chief dietetic articles in several European countries, taking the period 1860–71 (except for the Zollverein, which rested on earlier data). The following were shown to be the proportions of coffee then used per head of the population :—

	Lbs.		Lbs.
France	2.32	Norway	6.30
Great Britain	0.95	Sweden	3.28
Belgium	8.60	Denmark	4.90
Zollverein	3.94		

Taking, however, other returns we have at command of the imports of coffee retained for consumption, we arrive at the following results, showing the gross and individual consumption, which are somewhat different to those given above.

Estimate made for the year 1873 from the official returns of articles imported and retained for consumption in the various countries, chiefly from the 'Statistical Abstract for Foreign Countries':—

Countries.	Total Imports of Coffee taken for Consumption.	Average per Head.
	lbs.	lbs.
France	98,635,000	2·73
Belgium	49,771,000	13·48
Switzerland	18,779,500	7·03
Russia, European	14,740,920	0·19
Sweden	26,555,213	6·11
Norway	17,636,080	9·80
Denmark	26,035,652	13·89
Holland	72,395,800	21·00
Hamburg	178,715,936	..
Austria	76,876,576	2·13
Greece	2,131,367	1·42
Italy	28,511,560	1·00
United Kingdom	32,330,928	1·00
United States	293,293,833	7·61

If we examine the latest year at command, 1884, as far as official returns will allow, and assuming the total imports are taken for consumption, we arrive at the following proportionate results of consumption. But in some cases, as for Hamburg, Holland, and Belgium, there are doubtless large re-exports.

Countries.	Total Imports.	Average per Head.
	lbs.	lbs.
France	149,410,800	4·00
Belgium	44,381,000	8·00
Switzerland	20,197,860	7·01
European Russia	18,216,000	..
Sweden	31,234,311	7·00
Norway	16,218,400	8·90
Denmark	15,000,000	7·01
Holland	229,392,000	..
Germany (Hamburg)	210,608,300	4·50
Austria-Hungary	78,051,380	3·50
Greece	2,048,739	1·00
Italy	35,824,800	1·02
Portugal	5,192,000	1·00
United Kingdom	32,255,664	0·90
United States	534,786,000	10·50

According to the trade circulars of the leading brokers of Rotterdam, the deliveries of coffee in Europe and North America

in the last ten years were as follows, in bales of 60 kilogrammes:—

Year.	Europe.	United States.	Total.
1878	5,685,500	2,470,900	8,156,400
1879	6,257,800	3,117,100	9,374,900
1880	5,813,700	3,050,700	8,864,400
1881	6,159,500	3,405,000	9,564,500
1882	6,462,000	3,748,700	10,210,700
1883	7,355,200	3,634,900	10,990,100
1884	6,838,400	3,739,600	10,578,000
1885	7,221,800	4,018,200	11,235,000
1886	7,483,400	4,013,800	11,497,200
1887	6,089,600	3,096,200	9,185,800

This gives an average of about 10,000,000 bales annually, or 1,320,000,000 lbs.

From these figures it will be seen that the United States takes half as much coffee as the whole of Europe.

The following official returns of the imports of coffee in various countries may prove interesting for reference.

CONSUMPTION OF COFFEE in the UNITED STATES.

	Tons.		Tons.
1863	35,589	1883	252,626
1873	120,150	1887	193,500

This is exclusive of the consumption on the Pacific coast.
The average consumption per head was as follows:—

	Lbs.		Lbs.
1850	5.55	1880	8.90
1860	5.86	1886	11.00
1870	6.60		

FRANCE.

COFFEE IMPORTS in KILOGRAMMES.

1874	38,709,000	1881	64,696,000
1875	48,013,000	1882	63,838,000
1876	53,487,000	1883	68,252,000
1877	47,811,000	1884	67,914,000
1878	54,105,000	1885	68,369,000
1879	58,826,000	1886	68,233,000
1880	57,733,000		

The imports of coffee at Marseilles were as follows, in tons:—

1882	20,796	1885	17,857
1883	24,691	1886	15,126
1884	17,113		

BELGIUM.

COFFEE IMPORTS in KILOGRAMMES.

Year.				Kilos.	Of this was received from Holland.
1874	..	..	..	19,022,000	7,100,000
1875	..	..	..	21,892,000	7,900,000
1876	..	..	..	26,473,000	10,600,000
1877	..	..	..	20,386,000	9,700,000
1878	..	..	..	23,079,000	8,500,000
1879	..	..	..	24,962,000	9,300,000
1880	..	..	..	22,755,000	9,800,000
1881	..	..	..	25,364,000	9,500,000
1882	..	..	..	28,206,000	9,900,000
1883	..	..	..	28,507,000	11,400,000
1884	..	..	..	20,164,000	10,500,000
1885	..	..	..	26,216,000	11,000,000
1886	..	..	..	26,874,000	..

SWITZERLAND.

IMPORTS of COFFEE in METRICAL CENTNERS of 220 LBS.

1875	..	..	..	93,906	1881	..	..	..	97,834
1876	..	..	..	99,655	1882	..	..	..	95,489
1877	..	..	..	77,871	1883	..	..	..	95,943
1878	..	..	..	83,329	1884	..	..	..	91,763
1879	..	..	..	96,325	1885	..	..	..	89,444
1880	..	..	..	84,305	1886	..	..	..	97,639

COFFEE IMPORTED into RUSSIA in POODS (36 lbs.).

Year.		Poods.	Kilogrammes.	Year.		Poods.	Kilogrammes.
1874	..	443,065	..	1881	..	424,431	6,952,180
1875	..	457,396	..	1882	..	508,877	8,331,334
1876	..	500,589	..	1883	..	387,141	6,338,272
1877	..	287,038	4,701,682	1884	..	506,000	..
1878	..	417,221	6,734,060	1885	..	470,000	..
1879	..	472,448	7,638,698	1886	..	456,000	..
1880	..	500,064	8,191,048				

COFFEE IMPORTED into the SCANDINAVIAN STATES in KILOGRAMMES.

Year.		Norway.	Sweden.	Year.		Norway.	Sweden.
1875	..	6,850,000	9,919,988	1881	..	7,603,000	12,341,006
1876	..	7,225,000	11,307,384	1882	..	6,993,000	13,532,924
1877	..	7,397,000	10,813,595	1883	..	7,994,000	14,197,414
1878	..	6,101,000	10,593,072	1884	..	7,372,000	14,139,082
1879	..	7,229,000	10,302,102	1885	..	7,910,000	15,453,503
1880	..	7,167,000	11,309,048	1886	..	8,814,000	..

DENMARK.

IMPORTS in PUNDS (1·102 lbs.).

Year.	Coffee.	Chicory.	Year.	Coffee.	Chicory.
1874 ..	14,354,474	2,238,514	1880 ..	13,264,126	4,161,295
1875 ..	15,907,122	3,729,079	1881 ..	15,728,744	3,562,841
1876 ..	15,960,529	3,309,331	1882 ..	16,657,576	3,763,834
1877 ..	15,122,963	2,633,364	1883 ..	21,224,815	2,549,228
1878 ..	13,162,038	4,037,802	1884 ..	14,741,863	1,769,089
1879 ..	14,738,394	4,611,437	1885 ..	17,105,725	554,349

COFFEE IMPORTED into HOLLAND in KILOGRAMMES.

1874	83,958,000	1881	94,094,000
1875	110,037,000	1882	96,301,000
1876	84,540,000	1883	128,949,000
1877	110,629,000	1884	104,269,000
1878	93,465,000	1885	111,263,541
1879	95,935,000	1886	84,144,000
1880	96,583,000		

Of this last amount, about one-half, 53,245,328 kilogrammes were received at Rotterdam. In 1886 the imports at Rotterdam were only 46,413,088 kilogrammes.

The imports of coffee into Holland in 1887 were drawn from the following sources (in bales of 60 kilogrammes):—

Java	869,600
Padang	4,900
Menado	26,700
Macassar	73,800
Ceylon	100
England and Manila	600
Africa	30,300
Rio	1,400
Santos	98,700
La Guayra	15,900
Other countries	30,000

1,152,000

COFFEE OFFERED for SALE by the NETHERLANDS GENERAL COMPANY in BALES of 68 KILOGRAMMES, in the LAST TEN YEARS, with the PRICES REALISED for GOOD ORDINARY JAVA at the SALES.

	Total.	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.
	Bales.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
1878	878,837	51	47	49	47½	45	49	47	46½	42½
1879	887,950	42½	42½	42¾	42	41	40½	42	47½	50
1880	920,992	47	44½	40¾	39½	41	40½	39½	38	39½
1881	870,244	37¾	36½	36¾	33¾	37	37	35¾	35	35½
1882	866,148	29	30½	28¾	27½	27½	28¾	26¾	28	25½
1883	974,775	28	33½	33	30	29	29½	29¾	31¾	35
1884	943,449	34¾	32	28¾	29½	30	27	27½	26½	28½
1885	874,798	26½	25½	25½	25½	26	24½	24¾	26¾	25½
1886	768,078	25¾	26½	25½	26½	27½	30	34¾	34	39
1887	617,842	42	42	47½	57	53	52½	53¾	53½	46

COFFEE IMPORTED in 100 KILOGRAMMES for the GERMAN EMPIRE.

Year.	Hamburg.	German Empire.	Year.	Hamburg.	German Empire.
1874 ..	781,500	..	1881 ..	1,169,000	1,041,550
1875 ..	868,500	1,007,500	1882 ..	1,111,500	1,071,250
1876 ..	880,500	1,064,000	1883 ..	1,141,500	1,141,735
1877 ..	917,500	958,150	1884 ..	995,000	1,111,083
1878 ..	940,500	994,150	1885 ..	1,071,000	1,181,340
1879 ..	1,026,000	1,114,850	1886 ..	1,131,000	1,236,305
1880 ..	1,013,500	942,200			

AUSTRO-HUNGARY.

COFFEE IMPORTED and ENTERED for HOME CONSUMPTION, in METRICAL CENTNERS of 220 LBS.

1875	317,201	1881	357,935
1876	327,022	1882	378,197
1877	338,526	1883	338,323
1878	399,040	1884	354,779
1879	193,087	1885	367,303
1880	315,916	1886	375,594

ITALY.

COFFEE IMPORTED and ENTERED for HOME CONSUMPTION.

	Kilogrammes.		Kilogrammes.
1874	10,695,000	1881	14,138,000
1875	13,580,000	1882	14,091,000
1876	14,873,000	1883	15,344,000
1877	12,220,000	1884	16,234,000
1878	12,697,000	1885	23,596,000
1879	15,495,000	1886	10,851,000
1880	10,673,000		

PORTUGAL.

IMPORTS of COFFEE in KILOGRAMMES.

1874	1,548,000	1881	2,091,000
1875	1,691,000	1882	2,257,000
1876	1,777,000	1883	2,246,000
1877	1,702,000	1884	2,360,000
1878	2,075,000	1885	2,634,000
1879	2,099,000	1886	2,633,000
1880	1,919,000		

GREECE.

IMPORTS of COFFEE in OQUES of 2·84 LBS.

1867	779,377	1872	658,272
1868	691,319	1873	579,897
1869	715,685	1874	575,855
1870	620,857	1875	682,913
1871	717,129		

UNITED STATES.

IMPORTS of COFFEE in POUNDS.

1874	285,271,697	1881	455,190,000
1875	321,970,865	1882	459,923,000
1876	340,089,200	1883	515,879,000
1877	331,639,000	1884	534,786,000
1878	309,882,000	1885	572,600,000
1879	377,848,000	1886	564,708,000
1880	446,851,000		

ROUMANIA.

COFFEE IMPORTS in KILOGRAMMES.

1879	804,857	1883	1,243,193
1880	819,370	1884	1,272,015
1881	1,041,048	1885	1,400,295
1882	983,447		

EGYPT.

COFFEE IMPORTS, VALUE in PIASTRES (96 to the £).

1877	658,000	1882	23,385,000
1878	743,000	1883	21,791,000
1879	21,204,000	1884	26,903,000
1880	30,477,000	1885	20,179,000
1881	26,391,000	1886	17,594,000

From India about 10,000 cwts. are sent annually to Turkey, 17,000 cwts. to Arabia, 20,000 cwts. to Aden, and 12,000 cwts. to Persia.

IMPORTS in TONS for SIXTEEN DIFFERENT COUNTRIES for 1886.

France	70,000	German Empire	123,630
Belgium	26,350	Hamburg	113,100
Switzerland	10,000	Austro-Hungary	37,559
Russia	7,300	Italy	16,000
Norway	9,000	Portugal	2,000
Denmark (1885)	8,400	Greece	1,000
Sweden (1885)	15,000	United States	252,100
Holland	82,000	Roumania (1885)	1,400

COFFEE CONSUMPTION in the UNITED STATES, PER HEAD.

	Lbs.		Lbs.
1873	9·6	1879	7·5
1874	6·7	1880	8·9
1875	7·2	1881	9·0
1876	7·5	1882	9·0
1877	7·1	1883	10·0
1878	6·5	1884	10·2

The later average is not quite so high as stated, the consumption being taken on the census of 1880, whereas the population has increased since then by one million of immigrants alone, besides the natural increase.

Appreciation and determination of various Coffees.—The exact determination of the source or origin of any kind of coffee is a very difficult matter, and requires considerable knowledge, practice, and experience. The form, size and colour of the seeds serve, at the ports of arrival, as a fair criterion for establishing a first classification, but certain kinds undergo a second triage or assortment when imported, or with the dealers, hence the various kinds of coffee consist of a great many varieties.

The estimation of the commercial value of coffee, therefore, depends chiefly upon characters drawn from the place of production, the form, size, colour, smell, flavour, age and uniformity of the seeds; also on the presence or absence of foreign substances, such as dust, stones, stems, &c. The source of production, when known, is usually a good index, but even then there is always to be found some difference, according to the nature of the soil, the season, the state of ripeness of the beans, their mode of extraction and preparation. Thus, arid soils yield better qualities than low or humid ground; berries which have been decorticated by means of a mill and then dried in the sun are better than those which have been first soaked or prepared by desiccation and triturating the fruit.

The general form of the berry is not always a safe criterion for determining the source of the coffee, for forms of different kinds will often be found in coffee of the same origin. Thus, for example, Santos coffee possesses characters common to that of India, Oceania; and some sorts of West Indian and Bourbon coffee beans have sometimes a pointed extremity and at others a rounded end.

The different forms of beans may be ranged under three principal types, represented by Mocha, pointed Bourbon and Martinique. The first is small, rounded, and rather rolled; the second is of medium size, elongated and pointed; the third is large and flattened. But it must not be overlooked that in each of these sorts we find, besides the typical form, the two others as additions, and in some rare exceptional cases the coffees of all sources are found to have a mixture of these three forms, produced on the same plant. The planters at Bourbon sort or class the berries from the tree during the collection. This triage offers no difficulty. The fruit at the extremity of the branches only produce the Mocha form, that from the axis the Martinique form, and the intermediary fruit the Bourbon kind. The seeds diminish in size from the commencement of the branch to the end. This decrease in size appears to be the result of a marked abortion. These facts explain and are in accord with the theory which asserts that the nourishment becomes less strong in the branch towards the extremity.

The progress of cultivation leads to a predominancy of the plano-convex form, which is the normal character of the seed, and the Mocha, carefully collected, after some years furnishes a proportion more and more considerable of flattened beans. The rounded and selected seeds constitute the round coffee of the

Creoles, the Caracotello of the Spaniards, and the pea berry of commerce.

Occasionally a good estimate may be drawn from the convex or crushed shape of the dorsal face of the seeds, of the flat or excavated form of the opposite face, also of the disposition of the longitudinal sillon, which is straight or largely open, and of which the inferior extremity encroaches more or less on the dorsal face.

Coffee seeds vary in colour from brown to bluish green, and also in size. The following table, compiled at the close of 1883, will give an idea of the size of the berries and also the value of coffee from different localities.†

	No. of Seeds in a Unit Measure (about 2½ oz.).	Per cwt.
		s.
Fine brown Java	187	160
„ Mysore	198	130
„ Nilgherry	203	93
Costa Rica	203	70
Good ordinary Guatemala	207	56
„ La Guayra	210	70
„ average Santos	213	54
* Fine long berry Mocha	217	130
* Good ordinary Java	223	60
Fine Ceylon Plantation	225	92
* Good average Rio	236	52
Medium Plantation, Ceylon	238	78
* Manila	248	52
* Ordinary Mocha	270	100
* West African	313	40

Those sorts marked with an asterisk are irregular in size and colour, and have the appearance of being carelessly prepared; and the reason why Rio, Manila, and West African fetch the least money seems obvious enough.

The high prices of the Mochas leads one to think that there is something in a name, but the light colour of the seeds indicates probably not only a very complete ripeness when gathered, but considerable age as well, and be it remembered that coffee improves with age and will continue to improve for 15 or 20 years. The brown Java, priced at 160s., had not only very fine seeds, but it had been six or seven years in the island. Raw coffee improves by keeping; like wine it gains in quality by aging, but, as it loses in weight, dealers do not like to encounter this loss. Old coffee sometimes fetches extravagant prices, thus the merchants of the east coast of Africa will not sell coffee of two years old under 2s. a pound, and still older and drier coffees under 2s. 6d. a pound. This is also the case as regards the size of the seeds, which measure from nine to twelve millimetres long, by six or eight broad. Some coffees, as Brazil, Martinique, and Java, present an

† Lecture at the Parkes Museum, London, December 6, 1883.

equality of bean and pretty fair regularity, but this is not the case with those of Hayti, St. Domingo, and Mocha, in which will be found beans of different sizes. As a general rule, the sorts which have the finest flavour are those where the bean is of medium size. The very variable difference in the colour of the seeds results from different causes, such as the nature of the soil, climate, degree of maturity of the seeds, their mode of extraction, age, and kind of preparation. Coffee grown in elevated lands is of a light colour, while that raised in low and humid localities has a darker hue.

The berry is green when it has been extracted by maceration of the fruit, yellow when it has been prepared by trituration after complete drying, and usually greenish yellow when it has been *gregé* or prepared by the mill. It is, in fact, of a more or less lightish yellow when it arrives in a season tolerably dry. The colour of the beans may differ considerably in this respect, but be sufficiently alike, the shade of others, such as Rio and Santos, will vary considerably, being sometimes of a beautiful golden yellow, at others blue, green, grey or blackish.

Generally the coffees of the old continent and its islands (as Mocha, Bourbon, Ceylon, Java, &c.) are yellow and greenish yellow, while those of American origin (as Jamaica, Martinique, Guadeloupe, Hayti, Brazil, &c.) are green.

The greater part of the coffees, those of Hayti especially, which are most esteemed by consumers, have when fresh a sweetish odour and a very pronounced raw flavour. The weight of coffee depends greatly on its state of dryness. Hence an experienced French chemist tells us the driest coffees, the colour of which is in general a pale yellow, have a density, by measure, determined without heaping up, of about 500 grammes to the decimetre, while those of a greenish colour and which have only been gathered about one or two years will weigh on the average from 680 to 700 grammes or more to the cubic decimetre.

The odour *sui generis* of certain coffees will furnish a good test, but in most cases this needs great experience to apply it.

Green Mocha has an agreeable odour somewhat resembling that of tea. The coffees of Martinique and Jamaica have a pure pleasant smell, that of Porto Rico is much less agreeable. The odour of Brazil sorts is generally strong, without being always the same, because it is by this character that Rio and Santos coffees can generally be distinguished. Those of Java and Sumatra are penetrating or sharp, and that of Manila is very pronounced.

The taste and flavour constitute another special characteristic. That of Mocha is the best of all. Martinique coffee is very agreeable, while the coffees of Guadeloupe and Porto Rico are less so; Padang coffee is not so much esteemed as that of Java; Sumatra coffee is slightly bitter. Green coffee mostly arrives in commerce mixed more or less with broken berries, *débris* of husks, mouldy beans, and foreign substances such as dust, stones, bits of wood, and various seeds. It requires, therefore, in examining different kinds of coffee to have this element in view.

The coffee of Hayti, for example, contains a larger number of broken beans, dust, and a greater quantity of stones than that from any other quarter. The coffees from Rio, Santos, Martinique and Java are generally, on the contrary, well prepared, clean, and contain few foreign matters. Other sorts, as from the Cayes, Singapore and Macassar, have usually mouldy beans.

The stones found will necessarily correspond with the geological formation of the country where the coffee is grown, and hence differ notably. Those of Brazil, for example, will in nowise resemble those of Hayti; the stones of Santos being of a brick-red colour, friable, and of dimensions varying from a pin's head to a hazel-nut, whilst those of Rio are generally white, crystalline, and sharp, of various sizes, and will scratch glass. The stones of Hayti (Port-au-Prince) are greenish grey and ranging in size from a grain of sand to a large nut. Hence the stones and earth found mixed with the coffee may give some clue to the source of growth, but this can only be on first arrival, for dealers usually mingle one kind with another. Besides the stones, the imports, carefully prepared, of Rio and Santos coffees, contain little bits of wood, pieces of the boughs or branches of the coffee-tree.

The value of commercial coffee, it will be seen, therefore, depends upon the texture and form of the berry, and the colour, flavour and mode in which it has been prepared for market.

Finally, in a commercial appreciation of the various kinds of coffee, account must be taken of the relative proportion of caffeine which they contain, but this determination requires careful chemical analysis. The quantity of this alkaloid varies in different kinds of coffee. Messrs. Robiquet and Boutron found the following proportions:—

Yellow Coffee of Brazil	..	..	..	1.82
Martinique	..	..	..	1.79
Alexandria and Java	..	..	..	1.26
Mocha	..	..	..	1.06
Cayenne	..	..	..	1.00
San Domingo	..	..	..	0.89

Professor A. H. Church made an analysis for the Brazilian Consul in London in 1881, as follows:—

SAMPLE of RAW COFFEE from BRAZIL.

	In 100 parts.
Moisture	11.22
Oil and Fat	14.27
Matter soluble in water	24.87
Albuminoids or flesh-formers	6.96
Caffeine	1.18
Ash, or mineral matter	3.51
	62.01

Few persons have given attention to the analysis of coffee in a chemical point of view, since the article of Payen ('*Annales de Chimie*, 3 série, 1849, t. xxvi. p. 108.)

Long researches have been made to ascertain if from any one of the elements, caffeine, tannin, ash, albumen, &c., any cause could be found for the notable differences which gourmets find or seek in coffee. In a word, if by the aid of analysis coffees could be classed, as the brokers, dealers, and experts do, by the aid of physical signs, or by tasting the infusion, operations which demand, like other species of judgment, special knowledge and much practice, which very few persons have the opportunity of acquiring.

M. Commaille in a study of coffee ('Moniteur Scientifique,' 1876, p. 779) says he has after long experience been unable to do this, but he found that he could in a certain degree by testing chlorogenic acid, estimate the damage and alterations resulting from fermentation, &c. Many persons (for instance, M. Branson, 'Moniteur Scientifique,' 1874, t. iv. p. 626) writing on coffee consider that the quality depends upon the proportion of caffeine it contains.

M. Commaille experimented with 80 different sorts of coffee, chiefly Mysore; it contained 13 per cent. of water, and 1 litre weighed 700 grammes.

ANALYSES of COFFEE.

—	Commaille. Mysore Coffee, not dried.	Payen's Estimate on Mocha and Mar- tinique.
Water	6·3 to 15·7 (1)	10·0
Fatty substances	12·68	10 to 13
Glucose	2·60	..
Dextrine	..	15·5
Undetermined acid	..	..
Legumine, Casein	1·52	10·0
Albumen	1·04	..
Double Chlorate of Potass and Caf- feine	..	3·5 to 5
Acid, Chlorogenic	About 9·0	2·22 to 3·17 (2)
Caffeine, free	..	0·8
Total Caffeine (3)	0·42 to 1·31	1·815 to 2·250 (4)
Ash	3·882	6·697
Extract of Coffee in cold water ..	24·97	..
" " boiling water ..	37·20	..
" " by alcohol at 60° } per cent.	23·150	..

(1) The highest and lowest of 24 samples of coffee.

(2) 65·5 acid to 100 of salt, according to Payen.

(3) 29 of caffeine to 100 of salt, according to Payen.

(4) Free caffeine 0·8, and combined caffeine 1·055 to 1·450.

These figures are too high, as no one has extracted two grammes of pure caffeine per cent.

A practical subdivision of coffees admits again of ten or twelve categories of many varieties, which differ from each other, not only in the price, which is variable, but also by their quality, aroma, and source. This distinction is very essential to be known,

and I append the designations under which different sorts pass in commerce.

AMERICA.

- Brazil*—Rio (washed Rio, Capitania).
 Santos, and washed Santos.
 Minas-Geraes.
 Bahia (Caravellas, Muriteba, Valença, Maragogipi).
 Ceara.
 Andarahy.
 Pernambuco.
 Amazon.
- Antilles*—Haiti or San Domingo (St. Marc, Mole, Gonaives, St. Domingo, Port de Paix, Porto Plata, Cape Haitien, Port au Prince, Jacmel, Jeremie, Aquin, Cayes).
 Jamaica (plantation and ordinary).
 Porto Rico, Martinique, Guadeloupe (l'Habitant, le Bonefieur).
 Cuba (Santiago de Cuba, Havana).
- Central America*.—Guatemala (ordinary and gregé or pulped).
 Nicaragua.
 Savanilla.
 Costa Rica (ordinary and gregé).
 Honduras.
 San Salvador.
- Venezuela*—Porto Cabello (gregé).
 La Guayra.
 Maracaibo.
- Peru*—Carabaya.
 Huauca.
- Bolivia*—Yungas.
- French Guiana*—Cayenne (Coté de Remire, Montagne d'Argent, Kaw, Oyac).

AFRICA.

- West Africa*.—Madeira.
 Cape Verd.
 Senegambia (Cayengo, Rio Nunes).
 Gaboon, Benguela, Monrovia.
 St. Thomas (Principes).
 Angola (Encoge, Cazengo).
- East Africa*.—Reunion (Bourbon pointed, round, Mocha, Myrtle, Leroy, St. Leu, and Mauritius).
 Mayotte.
 Nossi-Bé.
 Mozambique (Inhambane).
 Madagascar (Tamatave).
 Natal.
 Zanzibar (Mocha).
 Berbera.
- Arabia*.—Mocha, Mocha of Aden, Hodeidah, Kusina, Dejibi, Aden.

ASIA.

- India*.—Bombay (Mocha).
 Mangalore.
 Mysore.
 Malabar.
 Wynaad.
 Tellicherry.
 Nilgheris.
 Salem.
 Ceylon (plantation and native).
- Cochin China*.

INDIAN ARCHIPELAGO AND PACIFIC.

- Java (Preanger, Demerary, Menado, Tagal, Malang, Solo, Tjilatjap, Samarang, Cheribon, Tenger, Kadoe, Pecalongan, Pasoeroean).
 Palembang.
 Padang.
 Celebes (Paré-Paré, Boeng, Macassar).
 Sumatra.
 Lucon (Manila, Zamboang).
Pacific—Tahiti.
 Fiji.
 New Caledonia.

Varieties of the Plant.—Botanists have enumerated about sixty species of the genus *Coffea*, spread over various countries in the eastern and western hemispheres. Most of these must be mere varieties resulting from accidents of soil, climate, or cultivation, produced subsequently to the naturalising of the plant, for we know that all the coffee trees now grown in America and the West Indies are the progeny of one plant introduced in the year 1714, and yet botanists have individualised as separate species the following:—

In Brazil—*C. australis*, *biflora*, *gardenioides*, *jasminoides*, *magnoliaefolia*, *major*, *meridionalis*, *minor*, *nodosa*, *parquioides*, *parvifolia*, *porophylla*, *sessilis*, *stipulacea*, *truncata*, *viburnoides*.

In Guiana—*C. guianensis*, *laurifolia*, *paniculata*, *stipulacea*.

In Mexico—*C. mexicana*, *obovata*, and *rosea*.

In New Granada—*C. spicata*.

In Peru—*C. nitida*, *racemosa*, *subsessilis*, *umbellata*, *verticillata*, *longifolia*, *foveolata*, *ciliata*, and *acuminata*.

In the East Indies we have, in India, *C. semiexserta*, *tetranda*, *travancorensis*, *Wightiana*; in Java, *C. densiflora* and *C. indica*; in the Moluccas, *C. pedunculata*.

In the Sandwich Islands, *C. Chamissonis* and *C. Kaduana*.

In Africa, the original *Coffea Arabica* in Arabia and Abyssinia; *C. laurina* in Sierra Leone; *C. Libérica* in Liberia; and *C. Mozambicana* and *C. Zanguebarica* in other parts.

Mr. W. P. Hiern, writing in the Linnean Society's Transactions, states that, as at present understood, the Linnean genus *Coffea* belongs to the Old World, and the numerous American species that have been previously referred to it now find places in other genera. All the species most valuable for economic or commercial purposes are confined to Africa, or are of African origin. Among the Indian species at least one, *C. bengalensis*, Roxb., a native of Silhet, was in former times cultivated in Bengal for the growth of coffee, but, being far inferior and not productive, it has been discarded on the introduction of the African plants.

Mr. Hiern, in his monograph, enumerates fifteen species, seven of which have been already described, and the remaining eight are new, or have not been previously described.

- | | |
|-----------------------------|-----------------------------|
| 1. <i>C. arabica</i> . | 9. <i>C. hypoglauca</i> . |
| 2. <i>C. Liberica</i> . | 10. <i>C. microcarpa</i> . |
| 3. <i>C. stenophylla</i> . | 11. <i>C. Afzelii</i> . |
| 4. <i>C. Zanguebarica</i> . | 12. <i>C. subcordata</i> . |
| 5. <i>C. brevipes</i> . | 13. <i>C. rupestris</i> . |
| 6. <i>C. melanocarpa</i> . | 14. <i>C. jasminoides</i> . |
| 7. <i>C. mauritiana</i> . | 15. <i>C. racemosa</i> . |
| 8. <i>C. macrocarpa</i> . | |

C. arabica is indigenous in Abyssinia, also on the slopes above the Victoria Nyanza, and in Angola, and probably in some of the intervening countries; cultivated, and often occurring spontaneously in Arabia and nearly all tropical and sub-tropical countries, including Madagascar and Natal; said to be wild along the Mozambique coast. It, with its numerous cultivated varieties, is the source of most of the coffee of commerce. A variety of this, *C. leucocarpa*, inhabiting Sierra Leone, may prove to be a distinct species.

C. Liberica inhabits Sierra Leone, Monrovia, and Angola, is the source of the Liberian coffee, and probably also of the Cape Coast coffee.

C. stenophylla, Don., is the Highland coffee of Sierra Leone.

C. Zanguebarica, Lour., is found on the Zanzibar coast and Mozambique.

C. brevipes, Hiern, found on the Cameron Mountains at an elevation of 2000 to 3000 feet by Mann.

C. melanocarpa, Welw., in the Angola country.

C. mauritiana, Lam., inhabiting high mountainous forests in Bourbon and Mauritius, called café manor, or wild in Bourbon. It is mixed with other coffees, for, if used alone, it is said to have intoxicating properties.

C. macrocarpa, A. Rich., in dense mountainous forests in Mauritius.

C. hypoglauca, Welw. Angola.

C. microcarpa, Dec. Senegambia.

C. Afzelii, Hiern. Sierra Leone.

C. subcordata, Hiern. Old Calabar.

C. rupestris, Hiern. Abbeokuta.

C. jasminoides, Welw. Angola.

C. racemosa, Lour. Mozambique.

Mr. Hiern excludes *C. laurina*, Poir. of Sierra Leone, which he refers to *Craterispermum laurinum*, Benth.

In 1877 Mr. Preston, the Colonial botanist, Trinidad, drew attention to the following species under experimental culture in that island: The Liberian, and a species from Cape Coast. The narrow-leaf *C. angustifolia*, received from Java, quite as new to Western cultivation as the Liberian, and eminently adapted for cultivation in poor, rocky or gravelly soils. It resists drought that would prove fatal to the ordinary Creole coffee. Its prolificness is very remarkable, and the size of the bean only second to that of the Liberian, but it is slower to develop than the ordinary coffee.

Souffrière, a variety of *C. arabica*, obtained from Dominica, hardy, vigorous, and proof against insects. The size of the bean unusually large, nearly equalling that of the narrow-leaved coffee last-named.

Mocha.—*C. arabica*, varieties major and minor. The rate of growth of the major is much faster than that of the minor, and at the same time it is more prolific. The bean is as round as, and a third larger than that of, the minor.

It does not appear (Mr. Preston adds) to be generally known that the Mocha coffee is rendered most prolific by scorching sun heat up to a point of making the trees lose their leaves to some extent, and thus it is that in the East the operation of gathering is often effected by drawing the branches through the hand, not picking the berries off the branches. Moreover, Mocha coffee trees in Trinidad are often seen in the leafless condition alluded to, laden with fruit.

Bengal Coffee.—This species differs from all others in its excessively compact habit of growth, its small and long bean, and specially in its adaptability for cultivation under other trees, luxuriantly, and being most prolific in dense shade. It is a second-class coffee in the market, chiefly owing to the shape of the beans, but it is recommended as a variety for planting in rows intermediate with cacao.

There exist numerous species of coffee trees, as, for instance, *Coffea arabica*, of which there are many varieties, as the Mocha, the Myrtle, the Aden, and the wild.

Coffea mauritiana, the wild coffee of Reunion.

Coffea Liberica, the coffee of Monrovia and Gaboon.

Coffea laurina, Sierra Leone.

Coffea amarello, the wild coffee with yellow berries (the most rich of all in *caffeine*), which is found in the forests of *Boturcateo*, in the province of San Paulo, Brazil.

Coffea vermelho, the ordinary red coffee of Brazil.

Cultivation.—The coffee tree succeeds in countries in which the temperature does not fall below 55°, but is very commonly raised in greenhouses in various parts of Europe and North America. It may be cultivated as far as 36° N. lat., where the mean temperature is about 70°. The cultivation within extra-tropical boundaries can only be tried, with any prospect of success, in the warmest and at the same time moistest regions, frost being detrimental to the coffee plant. The Americans of the States believe that the climate and soil of Florida would be favourable to coffee, as well as Lower California and a portion of Texas. This belief is rendered almost a certainty by the authentic statements that in these regions, at least in Florida and California, there is found growing in abundance a wild coffee plant with many of the characteristics of the cultivated plant. In California the experiment has been tried of planting Costa Rica seed, and the results are reported as satisfactory. Within the tropics coffee thrives best at an elevation of 1200 to 3000 feet, and rarely grows above 6000 feet. In Jamaica and Ceylon it is found to withstand cold well in

the high mountain ranges, and bears a large, plump, and aromatic berry. It takes its name from Coffa, a south-western province of Abyssinia, of which it is a native, and the common name is almost the same in all languages to which it has spread.

The trees are usually raised from seeds in nurseries, and afterwards planted out at regular distances, which vary according to the nature of the soil. Plantations are made chiefly on hills and the skirts of mountains, and, if possible, where the soil is moist and shaded. In dry and gravelly soils the coffee trees seldom grow higher than six feet, and may be planted five feet apart; but in rich soils, where they attain the height of nine or ten feet or more, the plants should not be so crowded, and intervals of eight or ten feet ought to be left between them. If not pruned they would rise to the height of sixteen or eighteen feet, but they are generally dwarfed to five feet for the convenience of gathering the fruit with greater ease, and also to prevent their running to wood. Thus dwarfed they extend their branches laterally, so that they cover the whole spot round about them. The trees produce fruit when they are two years old, and in the third or fourth year they are in full bearing. The produce of a good tree is from one and a half to two pounds of berries.

With the same infirmities that most other trees are subject to, coffee trees are likewise in danger of being destroyed by the borer and other insects, and occasionally by the scorching rays of the sun. In the West Indies and some other parts, large umbrageous trees, of various kinds, are planted in rows at intervals throughout a coffee plantation, to afford a shade and shelter to the young plants.

Coffee trees flourish in hilly districts where the subsoil is gravelly, for the roots will strike down and obtain nourishment, so as to keep the tree alive and fruitful for thirty years. This is, however, about the extreme limit at which the tree will bear fruit. Trees planted in a light soil and in dry and elevated spots produce smaller berries, which have a better flavour than those grown in rich, flat, and moist soils. The weight of produce yielded by the latter is, however, double that obtained from the former, and, as the difference in price between the two is by no means adequate to cover this deficiency of weight, the interest of the planter naturally leads him to the production of the largest but least excellent kind. It is the usual calculation that each bushel of ripe berries will yield 10 lbs. weight of merchantable coffee.

The aspect of a coffee plantation during the period of blossoming, which does not last longer than one or two days, is very interesting. In one night the blossoms expand themselves so profusely as to present the same appearance which is sometimes witnessed in England when a casual snowstorm, at the close of autumn, has loaded the trees, while still furnished with their full complement of foliage. The fruit is known to be ripe when it assumes a dark red or nearly purple colour, and in this state the pulpy covering begins to shrivel. If not then gathered the fruit will drop from the trees. The sweet pulp covering the seeds is in some countries distilled, and in other cases dried and used as a coffee substitute.

The fruit or berries are either gathered by hand into bags or baskets, or the trees are shaken and the fruit falls on sheets laid on the ground.

In curing or drying the coffee it is sometimes usual to expose the berries to the sun's rays, in layers five or six inches deep, on platforms or terraced floors, called *barbacues*. These paved *barbacues* are raised a little above the ground and enclosed with an upright stone ledge of eight or ten inches in height, and divided by transverse partitions into four or more square compartments, that each may contain a day's gathering. During the first and second days the berries are turned often, that the whole may be more exposed to the sun, but when they begin to dry they are frequently winnowed and laid in cloths to preserve them better from rain and dews, still exposing them to the sun daily, and removing them under cover every evening until they are sufficiently dried. By this means the pulp ferments in a few days, and having thus thrown off a strong acidulous moisture, dries gradually in about three weeks; the husks are afterwards separated from the seeds in a mill.

Other planters remove the pulp from the seed as soon as the berries are gathered by a pulping mill. The pulp is then separated from the seeds by washing them, and the latter are spread out in the sun to dry. It is then necessary to remove the membranous skin or parchment by means of heavy rollers. The seeds are afterwards sifted and winnowed to separate the chaff, and, if any among them appear to have escaped the action of the rollers, they are again passed through the mill.

In the ten years from 1861 to 1870, the coffee-growing countries produced nearly sixty-eight millions of cwts. of coffee. Of this, Rio alone supplied considerably more than a third; now Brazil furnishes more than one-half of the entire production of the world.

Production in Java and the Eastern Archipelago.—Although Brazil supplies the largest quantity of coffee to the world, as shipments go chiefly to the United States, hence I will commence with the second great coffee-producing country, Java, which, however, stands the first in precedence for the introduction of the coffee tree.

As early as 1696 the industrious Dutch carried the seeds of coffee trees from Carranova in Malabar to their colony in the far East, enlarged the enterprise rapidly, and were able by 1719 to appear in the great markets of the world with large supplies of coffee (30,000 lbs.) from Java. Encouraged by this success, they established similar plantations in Sumatra, Ceylon, and the Sunda islands. The French and the English followed their example, and in a short time the coffee tree had made the voyage round the world. In 1690 Governor Witsen presented a coffee plant to the Botanic Garden of Amsterdam, where it bore fruit and produced many young plants, from which the West Indies have been furnished.

In Java, which is situated six degrees south of the equator,

elevated forest clearings, between 2000 and 4000 feet above the level of the sea, are found to be the best suited for the growth of coffee; but it is cultivated in low lands also, although the tree does not last so long, and bears less fruit. Shade trees are used, and weeding is well attended to.

In some places the berries are dried with the pulp, but in the majority of cases it is prepared in the parchment by pulping, washing, and pounding with wooden pestles, and, by experienced planters, with more complicated machinery.

Java coffee has gradually acquired a reputation which its intrinsic value fully merits. The greatest care and attention have been bestowed on the cultivation there, it being not so much the wish of the Dutch Government naturally to increase the present extent of culture as to develop and strengthen the plant, in order thus to improve the quality and enhance the value of the bean. In San Domingo and other places over-cultivation and obvious neglect are doing much to injure the character of the product.

There are three prominent kinds of Java coffee brought into the Dutch markets—Jacatra, usually sold as Java; Cheribon, and Samarang. The first is the best; Cheribon is a little lighter colour, and of somewhat inferior quality. Samarang coffee has yellowish brown or green flattened beans, but what is generally sold as such is simply a kind of “trriage,” black beans of a coarse flavour.

Besides the Government culture there is a good deal of coffee raised by private growers.

The tree bears fruit there in the fourth year, and continues to yield up to the fifteenth year or longer. It blossoms generally three times in the year, so that it may be said there are three gatherings of the berry.

The comparative progress of coffee production in Java is shown by the exports, which were in

			Cwts.				Cwts.
1829	..	..	334,000	1869	..	..	3,299,000
1839	..	..	1,000,000	1879	..	..	2,000,000
1859	..	..	1,195,380	1884	..	..	1,250,000

The export has occasionally reached 170,000,000 lbs., and the production is regaining its old footing. The exports, however, include various receipts from the other islands, although shipped under the general designation of Java coffee.

The quantity of coffee delivered into the Government stores at Java and the private produce was as follows:—

Year.	Piculs of 135 lbs. Government.	Piculs of 135 lbs. Private.	Year.	Piculs of 135 lbs. Government.	Piculs of 135 lbs. Private.
1869	962,800	144,000	1875	494,000	122,000
1870	986,038	153,000	1876	1,266,000	203,000
1871	446,304	121,000	1877	875,000	185,000
1872	985,961	185,000	1878	851,000	116,000
1873	773,920	152,000	1879	1,250,000	226,851
1874	1,032,000	180,000			

The total since has been as follows :—

	Piculs of 135 lbs.		Piculs of 135 lbs.
1880	722,668	1882	1,298,542
1881	1,274,555	1883	1,375,500

In 1884 the crop of coffee (Government and private) exceeded 1,000,000 piculs. The crop in 1885 was only 500,000 piculs, but there was a recovery in 1886 to 816,932 piculs.

The export of coffee, husked, 1880-84, was	16,668,000	kilogrammes.
Exported, not husked, 1886, ..	7,859,000	"
" 1880-84, ..	25,264,000	"
Government crop in 1886, ..	817,000	"
" 1880-84, ..	1,037,000	"

The coffee of the private planters in Java surpasses in quality, and necessarily in value, that produced by the Government. The coffee planters, in view of the crisis they have suffered and the devastation arising from the coffee leaf disease, which first showed itself there in 1884, have diminished considerably their expenses and the outlay for production.

The exports of coffee on private accounts from Netherland India have been as follows :—

	Kilogrammes.
1875	35,671,225
1880	39,945,705
1885	24,621,195

The Java crop of coffee, in bales of 60 kilos., has been as follows :—

Years.	Government.	Private.
1877-78	826,267	341,000
1878-79	1,267,168	328,000
1879-80	558,795	297,000
1880-81	1,047,000	219,000
1881-82	1,007,600	326,000
1882-83	1,025,000	145,500
1883-84	1,072,000	309,300
1884-85	1,019,000	200,800
1885-86	500,000	325,000
1886-87	817,000	283,800

Sumatra.—After Java, Sumatra is the next island which raises coffee in large quantity, and as it has been greatly taken up by the native cultivators, the island now yields a considerable crop. The beans are dark brown, occasionally black, and the last kind is but of poor quality.

EXPORTS of COFFEE from NETHERLAND INDIA, JAVA, MADURA, and MENADO,
in KILOGRAMMES.

Year.	Government.	Private.	
	From Java and Madura.	From Java and Madura.	Other Places.
1872	42,704,780	20,098,001	9,717,179
1873	46,729,010	22,252,942	10,434,112
1874	43,784,967	21,431,419	9,939,444
1875	42,649,173	19,805,106	15,821,119
1876	51,879,720	21,626,499	13,504,287
1877	55,885,431	28,138,872	7,271,304
1878	37,361,575	13,704,537	12,283,209
1879	41,873,972	23,802,056	16,250,099
1880	45,598,616	24,439,279	15,506,426
1881	56,494,673	37,698,000	..
1882	51,608,906	35,665,000	..
1883	59,128,840	46,845,000	..
1884	49,010,115	41,055,000	..
1885	25,659,027	30,312,000	..

PADANG COFFEE.

				Piculs.					Piculs.
1875	..	..	..	160,844	1881	..	..	..	101,805
1876	..	..	..	141,780	1882	..	..	..	98,534
1877	..	..	..	141,854	1883	..	..	..	135,824
1878	..	..	..	124,175	1884	..	..	..	133,964
1879	..	..	..	103,504	1885	..	..	..	137,580
1880	..	..	..	134,633	1886	..	..	..	62,759

The crop seldom exceeds 170,000 piculs. In 1857 it was 190,900, in 1874, 131,474, and in 1877, 175,000 piculs. At Palembang about 34,000 piculs are grown.

The formation of regular coffee plantations by the natives was commenced in *Celebes* in 1822. By the beginning of 1855 there were more than 5,000,000 coffee trees planted in Minahassa, but not all planted are yet bearing. In some districts the produce is as much as 2 to 4 lbs. per tree, while in others it is only from a half to three-quarters of a pound. The general character of the coffee is not very good, little care being given to the preparation; but the quality of the beans from Menado is better and of a palish green.

Macassar is at present the centre of the coffee trade, where the crops of South Celebes and of the islands of the eastern part of the Archipelago are brought to market. The imports in 1877 amounted to about 70,000 piculs from the Government lands of Celebes, 25,000 from the Principalities of Celebes, 18,000 from Timor, and 7000 piculs from East Bali, Lombok, Sumbawa, and Boeton, aggregating 120,000 piculs, of which nearly one-fourth was exported to Java and Singapore, and the remainder to Europe direct. The mountain regions of the southern and eastern districts, and also those of the northern districts, can compete with

the best coffee soil of Java, as regards their suitability for the cultivation of that staple. The total coffee production of Bali and the other small Sunda Islands is at present about 40,000 piculs. In Celebes the production is very variable, ranging from 23,000 piculs to 118,000 piculs.

In 1880 the following estimate was officially made by Dr. Van der Berg, V.-P. of the Batavia Chamber of Commerce, of the yield of coffee in Netherland India:—

	Piculs.
Java, Government	999,000
„ private	168,000
Sumatra, Government	127,000
„ private	20,000
Celebes, Government	20,000
„ private	95,000
Bali and the other small Sunda Islands ..	50,000
	1,479,000
	= 1,782,723 cwt.

EXPORTS of COFFEE from SUMATRA and CELEBES, both on GOVERNMENT and PRIVATE ACCOUNT, in PICULS.

Year.	Sumatra.	Celebes.		Total Piculs.
	Padang.	Macassar.	Menado.	
1853	119,420	6,000	16,115	141,534
1863	129,357	36,000	13,187	178,544
1873	97,805	83,857	10,769	192,853
1883	144,800	116,609	10,289	271,693
1884	90,520	115,602	17,070	223,192
1885	102,825	115,592	23,561	242,078

At *Timor* the Portuguese are encouraging the culture of coffee, and the best results are expected from the plantations made, although as yet the yield is small.

Fifty coffee trees are found in the course of four or five years to yield here $1\frac{1}{4}$ cwt. of coffee; but it is only by purchasing the coffee from the natives that the authorities can get coffee production extended. At *Amboyna* some 50,000 trees have been planted.

Coffee in the Philippines.—This coffee is quite equal to that of Java; the beans are medium sized, and of a pale greenish colour.

The plant thrives wonderfully in the Philippines, and its berry has so strongly marked a flavour that the worst Manila coffee commands as high a price as the best Java. In spite of this, however, the amount of coffee produced in the Philippines is very insignificant, and until lately scarcely deserved mention. In the early part of this century the coffee plant was almost unknown there, and represented only by a few specimens in the Botanical Garden at *Manila*. It soon, however, increased and multiplied. The Economical Society bestirred itself by offering rewards to

encourage the laying out of large coffee plantations. In 1837 it granted to M. de la Gironnière a premium of 1000 dollars for a coffee plantation of 10,000 trees, which were yielding their second harvest, and four premiums to others in the following year. But as soon as the rewards were obtained, the plantations were once more allowed to fall into neglect. From this it is pretty evident that the enterprise in the face of the then market prices and the artificially high rates of freight did not afford a sufficient profit.

In 1856 the exports of coffee were not more than 7000 piculs, in 1865 they had increased to 37,588, and in 1874 to 45,842. This increase, however, affords no criterion by which to estimate the increase in the number of plantations, for these make no returns for the first few years after being laid out. But even greatly increased exports could not be taken as correct measures of the colony's resources.

Not till European capital calls large plantations into existence in the most suitable localities will the Philippines obtain their proper rank in the coffee-producing districts of the world. The best coffee comes from the provinces of Laguna, Batangas, and Cavite, the worst from Mindanáó. The latter, in consequence of careless treatment, is very impure, and generally contains a quantity of bad beans. The beans of Mindanáó are of a yellowish white colour and flabby, those of Laguna are smaller, but firmer in texture. Manila coffee is very highly esteemed by connoisseurs on the Continent, and is expensive, though it is by no means so nice looking as that of Ceylon and other more carefully prepared kinds.

Considering that coffee grows with the greatest facility in the provinces, and that its quality is considered excellent, it is indeed surprising that its culture is so limited. The export of coffee from Java and its dependencies is probably now 1,500,000 piculs, whilst that from the Philippines is but 60,000 piculs per annum.

Cultivation in Ceylon.—Ceylon soon became the most important coffee-producing country of the British possessions. It would seem that the tree was taken to that island by the Dutch a little over two hundred years ago, but the first regular estates were only opened in 1824, when Sir Edward Barnes and Sir George Bird commenced planting.

Coffee planting had been gradually extending up to 1844, and a considerable breadth of land of what would now be called low country estates, that is, land planted at an elevation from 1600 to 2500 feet, was then in full bearing. Up to this period the English consumption of coffee, restricted by a complicated system of differential duties, had been almost entirely confined to the produce of the British colonies and a small quantity of superior Mocha.

It was known that within the tropics both Demerara and Berbice produced a coffee of highly approved quality in the London market. These countries lying at the level of the sea, a large quantity of the coffee of Jamaica being also grown on the plains of Liguanea, very little above the seaport of Kingston, and Mocha coffee being also supposed to be produced in a dry and hot

country,* the effects of temperature or altitude were forgotten or not considered to be a necessary condition. It may be observed also that elevation and temperature, though they may be on the average the same in two different countries, are still not equal as conditions, inasmuch as soil, neighbourhood of, or distance from, mountains, combine to form other and varying circumstances, in which few countries can be found absolutely to agree. Whilst Demerara rejoices in a similar temperature, she possesses a rich alluvial soil of many feet in depth, not liable to be removed by the rains, whilst Jamaica has a rich volcanic soil on her lower hills.

The hill region of Ceylon covers an area of about 4000 square miles, is of a somewhat circular form, and its most elevated parts rise to 8280 feet above the level of the sea. Systematic cultivation is almost exclusively carried on on these hills, although irregular native garden plantations are found everywhere in the south-western portion of the island, even close to the sea-beach. The favourite elevation is between 2000 and 3500 feet, but in a few exceptional cases estates descend almost to the foot of the hills, whilst others are situated at 5500 feet, and even higher. The number of systematically worked coffee estates scattered all over these hills was in 1875 about 1100, covering an area of perhaps 440,000 acres, of which about 220,000 were cultivated, producing nearly 1,000,000 cwts. of clean coffee, worth on the spot, say £3,000,000 sterling, and giving employment to 912 superintendents and assistants, and upwards of 200,000 persons, chiefly Tamil labourers from the coast of India. This was exclusive of about 50,000 acres of coffee grown by natives. At the present time the acreage under coffee is only 143,000 acres.

The coffee estates in the Badulla district are situate in two different directions; those on the Badulla side lie in an easterly direction, and are mostly on spurs running out from Nammanakolie Kande, and those in a south-westerly direction on the Happootelle ranges. The elevation of the estates above the level of the sea is from 2400 to 4800 feet. Those on the Happootelle side are from 25 to 37 miles from the town of Badulla; those on the Badulla side from 3 to 12 miles. Badulla is 156 miles from Colombo, and 84 from Kandy. The heavy blossom appears in August and September. The principal crop is picked from April to July. A small crop, chiefly from young coffee, is picked from September to December.

The coffee production in Ceylon is shown by the following figures of the exports at decennial periods:—

	Cwts.		Cwts.
1836	60,329	1866	899,480
1846	173,892	1876	888,774
1856	445,568	1886	179,254

In each of the two years, 1868 and 1870, the shipments exceeded one million cwts.

* Mocha coffee, as may be seen by the bean, is grown both on lowlands and likewise on mountain heights, which makes the distinction of greenish small berry and the Patna kind.

In commencing coffee planting the first step is the selection of ground. A virgin forest soil on the slopes of the mountains about 3000 feet above the level of the sea is most suitable. A convenient spot should next be chosen for a nursery to be planted with seed or parchment coffee. The forest should then be cut down, lopped, and in five or six weeks burnt. When the clearing and roads are finished, the ground should be lined, holed, and planted with plants from the nursery, which will be then from nine to twelve months old. Coffee grows well at Kaigalle, Korne-galle, and in the Doombera valley between 800 and 1500 feet above the sea. In Ouvrah coffee bears well at between 4000 and 5000 feet above the sea, owing to the dry air and climate; while, on the more western side of the island, at the same elevation, it either bears only 2 or 3 cwts. an acre, is a mass of leaves, or gets covered with black bug; the two latter being chiefly caused by the extreme quantity of rain that falls. A dark chocolate-coloured soil, mixed with small stones, under ledges of rock, and bestrewn with boulders, is the most suitable for coffee trees; and the best medium elevation is, say, 3000 feet above the level of the sea. In forming a nursery one bushel of parchment coffee is calculated to yield about 30,000 plants; so that for a clearing of 100 acres, four or five bushels of seed would be required. The placing of the plants in the holes is the one operation that requires the utmost care and attention. The planting season commences in May, and extends to the end of November. During the growth of the plants the ground must be kept clear of weeds, and the buildings for machinery, according to a good plan, should be at once commenced. By the time these buildings, together with the machinery, are erected (say three years) the coffee is ready to be picked.

The next operation, and by far the first in importance, is pulping the coffee. The machine most extensively used is an Improved Pulper, manufactured by John Gordon & Co., London, who have for many years supplied the Ceylon and Indian planters with this and every other kind of coffee machinery. The coffee is run into the pulper by means of a stream of water. Here the pulp is separated from the seeds, which fall into a cistern, where they remain from eighteen to twenty-four hours without water. After this time has elapsed the cistern is supplied with running water, and all the glutinous matter is by this means washed away. On some plantations a washing machine is used. It is then dried by a machine made for the purpose, or in the sun. Having been stored away for two or three weeks, it is again placed in the sun to finish drying. This is completed if the bean crack freely between the teeth, and it is not until then ready for the peeling-mill, which removes the parchment and skin from the bean. It is next passed through the fan or ventilator into a sizing machine (about eighteen feet in length), which takes out the broken coffee, and separates the beans into different sizes. This not only causes the coffee to roast equally (a quality which raises its value in the market), but also separates the pea-berry, or round coffee, which brings a much higher price.

Coffee Pests.—Coffee is a remarkably hardy plant, thriving at various elevations, and under the most different conditions of moisture, soil, and temperature. It is, however, liable to the attacks of certain insects, amongst which the borer (*Xylotrechus quadripes*) is the most formidable. Hardy as it is, the tree is a dreadful sufferer, and there is scarcely a time when it is entirely free from disease within, or from attacks of enemies from without. Grub, borer, bug, drought, the damp and the leaf disease, are a few of its enemies, and it will be well to touch upon some of these.

The coffee-leaf fungus (*Hemilia vastatrix*) has been a great anxiety of the coffee planter. Leaf disease in coffee assumed an aspect so serious that the fullest possible investigation into its cause, nature, effect, and the possible remedies became essentially necessary.

The fungus, Mr. J. Hamilton tells us, was first noticed in 1869, on an estate in Madullisama, and is supposed to have originated first on a jungle plant in the forest near the plantation. From thence it has spread all over Ceylon, India, Java, Fiji, and down to the Cape; in fact over the entire eastern hemisphere of the coffee-producing world. It has not yet made its appearance in Brazil or the West Indies. For some years its effects, although felt, were not considered as likely to be a permanent evil. Many thought, with manure and high cultivation, that more than passing effects could be staved off indefinitely.

The coffee tree, like the laurel, does not naturally shed its leaves, but the disease changes the whole nature of the plant, and causes it to shed its leaves sometimes two or three times in the year, with the result of destroying its cropping wood and impairing the vigour of the plant. In 1875 there were in Ceylon 237,345 acres under coffee, producing 988,328 cwts. In 1885 there were but 127,000 acres, producing 200,000 cwts. The appended table will testify more accurately than words can paint what Ceylon proprietors have passed through by the failure of the crops and the fall in prices:—

Years.	Crop.	Value per ton.	Total.
	Tons.	£	£
1879-80	33,400	100	3,340,000
1880-81	22,290	90	2,006,100
1881-82	28,000	80	2,240,000
1882-83	12,900	70	903,000
1883-84	16,200	65	1,053,000
1884-85	15,500	60	930,000
1885-86	9,000	60	540,000

The local consumption of coffee in Ceylon is estimated at from 50,000 to 100,000 cwts.

Production in British India.—Passing from the island of Ceylon, we reach the peninsula of India, where, under British enterprise, coffee cultivation made rapid progress from the greater facility of

obtaining labour. It is this insuperable difficulty which has crippled production in our West Indian possessions, and led to the transfer of the culture of many of the leading staples of commerce from the western to the eastern hemisphere.

Coffee soon became a much more important article of agriculture in India, Ceylon, Java, and Brazil, than in its native countries. The origin of coffee culture in India is due to some refugees from the Philippines, and has been detailed circumstantially by the late Mr. J. S. Buckingham. Suffice it to say that about 1820 an insurrection of the native Indians of the Philippine Islands, against their conquerors the Spaniards, drove almost every white man from that country, and some few of these sought refuge in Calcutta. Among others were two Frenchmen who had been for some years successful cultivators of coffee at Manila, but who, though wealthy by their possessions there, barely escaped with their lives. A subscription was raised for them by the merchants, money advanced, the requisite land purchased, the coffee plant cultivated on it; and from this source has sprung all the subsequent increase which makes the present production of India about 50,000,000 lbs.

The production of Indian coffee is confined almost entirely to the Madras Presidency, the native States of Travancore, Mysore, and Coorg, all sections of the Western Ghat range, but there are numerous estates on other isolated hill ranges, such as the Shevaroyes, Anamalais, &c. The coffee districts under the Madras Government are Wynaad, Nilgiris, Tinnivelly, Shevaroyes, and Anamalais. There is a large and increasing home consumption of coffee in India. The fluctuations of the trade, which are often considerable, are to be explained by the deficiency or abundance of crops, according as the season is unfavourable or the reverse. Crops have often been materially affected too by the ravages of the "borer," by rot, as well also (and this is a large element in the influences which have from time to time affected injuriously the out-turn of the crops) by the want of knowledge of proper conditions of culture on the part of those engaged in the cultivation, both Europeans and natives.

The cultivation has now settled down into a steady industry, in which natives are largely occupied as well as Europeans; but, like tea, before attaining this last stage, it went through all the phases of wild speculation. From 1800 to 1863 or 1864, there was quite a mania for the cultivation of coffee. Land was bought recklessly, without regard to its suitability, cleared and brought into cultivation at enormous expense, and, in many cases, ruinous loss ultimately. Great sums of money were wasted in this speculative period, which was followed by the inevitable reaction and depression. This period has long passed, and planters understand now that they cannot hope for the visionary profits of which they were formerly assured; but the cultivation of coffee is, with care and intelligence, a steady and prosperous support to those engaged in the industry.

It is a noticeable fact, as showing the wide range of the plant,

that in many of the countries where coffee culture has been introduced, species have been found indigenous, such as *Coffea alpestris*, *grumeloides*, and *Wightiana*, in the Nilgiri hills; *C. Mauritiana*, in Bourbon; and *C. Liberica*, in Western Africa.

Although the coffee tree will not refuse to grow and even bear crop in countries subject to frost and snow, and extreme warmth is not absolutely necessary to its existence, still experience shows that it flourishes and bears fruit abundantly only within the tropics. In Southern India and Ceylon the elevation at which the estates are situated varies considerably, from nearly 6000 feet above sea-level to so low as 400 and even 300 feet. It has been asserted that coffee requires a great deal of moisture; and a humid atmosphere, combined with a warm temperature, will encourage trees to bear most heavily. The latter requirement must not be overlooked, as it is well known that, on very elevated estates, where an almost perpetual mist and frequent rains furnish more than an adequate supply of moisture, but where, however, the air is seldom warm, even when the sun shines brightly, the coffee trees, even in sheltered situations, though they sometimes present a healthy and even luxurious appearance, bear but very little crop. Such situations also prove, in many cases, strongholds of the blight called black bug. Hence few experienced planters would think of establishing a garden at an elevation above 4000 feet; though, if the aspect and soil be exceptionally favourable, coffee may thrive well and yield heavy crops at an elevation of even 6000 feet. In situations between 2000 and 4000 feet above the sea-level, the climate and temperature required by coffee will generally be found. In elevations below 2000 feet, the great heat of the climate causes so rapid a growth of vegetation that it is extremely difficult to keep down the weeds, and where, as at a tolerable elevation, one monthly weeding would be amply sufficient, two at a lower elevation would be quite necessary to keep an estate clean. Moreover, the malarious atmosphere of estates in low situations is a condition which, though suited to the coffee plant, is not conducive to human health.

The most suitable soil in the East Indies for the coffee plant is that which grows soft timber. The latest authorities seem to confirm the opinion of Laborie, who observes: "If the first or tap-root finds the gravel, stone, or clay, the tree will not last long; but if it, as well as the roots, find their way through the stony ground, and if there be a good proportion of mould, it suffers no inconvenience, as the stones keep the mould together." The finest estates are said to be of this latter character of soil, and have given consecutively heavy crops, with the assistance of little or no manure; while estates of a lighter soil, having lost nearly all the mould, and having no good subsoil, require to be regularly manured. In a word, a dark chocolate-coloured soil, mixed with small stones, under ledges of rock, and bestrewn with boulders, is the best, and the most favourable elevation is 3000 feet. A level piece of virgin ground, not far from water, where the soil is rich and crumbly, is the most eligible for the construction of a nursery.

First, the land must be thoroughly cleared, and all but the largest stumps of the forest trees rooted out; the soil should be dug to the depth of nine or twelve inches, and be made as friable as possible, then divided into beds with narrow paths between them; the seed, in parchment (generally taken from the cistern after being pulped), should be put in, row by row, about six inches apart. A rope, the length of the beds, is used for this purpose, stretched from one end of the bed to the other. The seed, if sown in suitable weather, soon makes its appearance above the surface; so that a nursery made in May or June of one year has plants fit to put out at the same date in the following year. A slightly inclined piece of land is more desirable for a nursery, because the natural drainage would be better; and it is important that care should be taken to prevent damage by heavy rains. One bushel of parchment coffee is calculated to yield about 30,000 plants; so that for a clearing of 100 acres four or five bushels of seed would be required. When the young trees in a nursery have attained a growth and age at which their being planted out as plants becomes rather a doubtful proceeding, with reference to the probability of their succeeding and taking root, it is better to make "stumps" of them; this is done by pulling them up with as little injury as possible to the roots, and cutting them down to about six inches above the roots; then to shorten the tap-root by a careful sloping out; next, to trim the other lateral roots, which are often needlessly extended. Filling-in is the operation that follows holing. It has been ascertained by experience, that leaving the holes open for some time is very beneficial to the soil in a chemical point of view. Filling-in, like every other work on a coffee estate, should be carefully superintended. But of all operations in the formation of a coffee plantation, the actual placing of the plants in the holes is the one that requires the utmost care and attention. Early planting is, of course, desirable, because the trees have the benefit of the entire rainy season, and are sure to give a larger maiden crop. The usual course of transferring the plant is as follows: When pulled up, those with crooked roots should be picked out and thrown away, the roots should then be trimmed with a sharp knife, diminishing the length of the tap-root sufficiently to prevent the chance of its being bent or broken. The plant should not be put deeper into the earth than it was before it was pulled up; it must then be pressed down with the hands or firmly trodden down. A coffee plantation, to be worked effectively, requires to be well "roaded" and drained. Drains, like roads and paths, should be cut as soon as the estate is commenced.

The extension of coffee cultivation in the hill districts of Southern India has been very remarkable. It was commenced experimentally in the Wynaad in 1840, and in 1862 there were 9932 acres under cultivation in that district alone. In 1865 Wynaad coffee cultivation had increased to 200 estates, covering 14,613 acres. The exports in 1860-61 amounted to 19,119,209 lbs. In 1873 the total number of holdings was 6913, of which 195 belonged to Europeans, and 6718 to natives.

In 1874-5 the extent of coffee cultivation in Wynaad had increased to 32,180 acres. The total value of the land under cultivation was £965,430, and the amount expended annually in coolies' wages alone was £182,500; other expenses in connection with cultivation, carriage, and shipment of crops, amounted to £100,000. There were altogether 117 European planters, 16 of whom were in North Wynaad, 74 in South Wynaad, and 27 in South-East Wynaad.

In the mountainous province of Coorg the cultivation of coffee by European enterprise was commenced in 1854, and there were in 1874 73,306 acres under cultivation.

The coffee trade which is located in Southern India has for some time been in a depressed condition. In 1885, the area under mature plants was estimated at 186,326 acres. Of this acreage, 81,754 was the share of Mysore, 55,143 of Madras, and 43,000 of Coorg.

In 1886, the following was the position of coffee culture in British India:—

—	Madras.	Mysore.	Coorg.
Number of plantations	16,571	27,238	4,865
Acres under mature plants	53,094	75,119	43,800
„ under immature plants	6,313	27,569	7,250
Approximate yield lbs.	12,167,800	10,153,481	8,133,440
Average per acre of mature plants } lbs. }	229	135	183

The total yield, adding the feudatory states of Cochin and Travancore, was in 1886, 31,355,487 lbs. The exports of coffee from Travancore and Cochin in 1886 were 1,551,189 lbs. There were about 100 acres under coffee in Assam.

On the Malabar coast some excellent coffee is grown, as well as in the hilly regions of Mysore and on the slopes of the Nilgiris. From these two latter places the finest growths of coffee are now being raised, more especially from Mysore, the prices obtained being considerably more than for Mocha. Very good specimens of coffee have also been produced in the interior of India, as in the district of Chota Nagpore, where the culture might apparently be greatly extended, and be of great benefit for consumption locally.

The quantity of coffee exported from India in the year 1873-4 was 2749 tons; in 1875 the quantity increased to 3316 tons; in 1886 and 1887 it averaged 18,500 tons, but in 1888 it fell to 13,600 tons.

The slopes of the hills that rise on the plateau of Mysore are thickly clothed with coffee plantations, and in the Munzerabad and Nugger districts coffee is even planted under the shade of forest trees, to obtain the requisite temperature; so that there is hardly a spot of land fit for coffee culture that is left uncultivated.

The coffee estates in Coorg may be classified into three groups: the Mercara plateau, the Ghat and the Bamboo estates. Each

group has its peculiar characteristics, advantages, and disadvantages. The Mercara plateau has an average elevation of 3500 feet, and, in the higher planted portions, rising to upwards of 4000 feet, enjoys a bracing climate, being equally exposed to the sweeping monsoon rains and to the dry east winds. With an average rainfall of 121 inches, extended over almost the whole year, the moisture is ample. The granitic soil consists generally of a red felspar clay, more or less mixed with gritty ferruginous stones, and covered with a layer of humus.

The slope of the land being steep, it is evident that unless cultivation is carried on with due precaution against the "waste" of the surface soil, by terracing, draining, or a judicious system of weeding, the trees will in a few years be deprived of the coolest and most nourishing portion of earth, and the land become sterile. Artificial shade is not required.

It has been found that high mountain coffee, when properly cured, picked, and sized (three distinct operations), contains an amount of aroma and essential oil much in excess of descriptions produced at low elevations.

Coffee is grown in *Jamaica* at all heights from the sea-level up to 5000 feet. The quality at the lower altitudes is inferior, but at a height from 3500 to 5000 feet, the produce is the finest in the world. The exports have been :—

					Cwts.					Cwts.
1854	..	..	..	..	43,059	|	1885	..	..	80,657
1874	..	..	..	..	92,065	|	1886	..	..	54,919
1884	..	..	..	..	48,357	|				

The following distinctive features of superiority are manifested in the *Jamaica* coffee—the striking blue colour, the perfect form, and unity of appearance of the berries, and the almost complete absence of the "silver skin."

Liberian coffee is being generally planted, and will soon occupy a prominent position in the produce market. It is successfully grown in the plains.

In *Jamaica* two very distinct classes of coffee are produced. The total export is about 84,000 cwts. per annum. Of this about 10,000 cwts. is *Blue Mountain* coffee of the finest quality, consigned almost entirely to the *Liverpool* market, where it sells from 100s. to 142s. per cwt. The remaining portion of *Jamaica* coffee, grown chiefly by negro settlers, is badly cured, and hence fetches comparatively low prices.

Hayti, which owed its former prosperity to coffee, has not yet again attained to the quantity it used to produce when a French colony. In 1789 the coffee crop there was 80,000,000 lbs. The trees were almost entirely destroyed in subsequent years. In 1826 the production had, however, recovered to 32,000,000 lbs.; in 1860 it had advanced to 50,000,000 lbs., and in 1863 to 68,140,752 lbs.; but it is now retrogressing: the exports were 60,666,000 lbs. in 1873, and 51,703,000 lbs. in 1883.

Cuba was at one time a large coffee-producing island, for in

1847 there were 2064 plantations under culture with this crop. From 1830 to 1840, the annual production was about 2,000,000 arrobas of 25 lbs. From the year 1841 to 1846, the average yearly production was 45,236,100 lbs. In 1851, owing to the fall in price of coffee and the more remunerative character of sugar and tobacco production, the crop had declined to 13,000,000 lbs.; in 1864 the export of coffee fell far below this, and now Cuba imports supplies of coffee from Porto Rico. In 1878 there were 192 cafetales or plantations for the growth of coffee.

In *Porto Rico* the coffee crop now averages about 230,000 cwts. In 1839 the shipments were only 85,384 cwts.; in 1861, 129,000 cwts.; in 1873, 270,895 cwts.; and in 1883, 335,000 cwts.

The cultivation of coffee has increased of late years, and might be much extended on land now almost unproductive, on the hills and valleys of the table-lands. The coffee of Porto Rico is of excellent quality; though not well known in the English markets, it is much appreciated in Spain and Italy, and even now exported to the value of over £900,000. A considerable quantity is grown in the province of Ponce, but it is also raised in the provinces of Mayaguez, Arecibo, and Aguadilla.

St. Lucia, Dominica, and St. Vincent should be great coffee producers on their mountain slopes, and Nevis and St. Kitts on a lesser scale. St. Lucia used to have 500 acres under culture with coffee, and in 1840 exported 324,000 lbs. In 1829 Grenada shipped 64,654 lbs.

Trinidad.—In 1796 there were 130 coffee plantations in Trinidad, and the produce there in 1803 was 358,660 lbs. The export from Trinidad averaged 24,000 lbs. in each of the four years ending 1875, but it is not likely to attain to the former proportions grown, even with the increased care and attention given to the culture, for the South American competition is too strong.

Latterly more attention has been directed to coffee culture, and several persons have been induced to try it on a somewhat larger scale than heretofore. A ready sale can always be found for it in the local market. 74,000 lbs. were exported in 1877, but the shipments are now only from 60,000 to 74,000 lbs.:—

								Lbs.
Exports in 1881	..	..	..	..	..	..	..	41,640
„ 1882	..	..	..	..	..	..	..	73,200

Coffee grows wild in Trinidad, but hitherto the quality as sent to England so far has not been of a high order. Now that Ceylon coffee is gradually disappearing on account of the wholesale conversion of the coffee into tea estates, or destruction of the trees themselves from disease, an effort should be made to produce a coffee of fine quality, which is always saleable in Europe at a remunerative price. At the same time it cannot be expected that Trinidad, with its comparatively low-lying lands, will produce as fine a grade as that received from the highlands of Ceylon and Jamaica; nevertheless, the crops from the virgin lands of Trinidad would be very heavy and the profits considerable.

The method of curing coffee throughout the West Indies is by passing it through a mill when it is gathered ripe, and, after this operation, it is put into cisterns and covered with water for ten or twelve hours until the pulp becomes loose, when it is washed, and the coffee being in its husk, is thrown in heaps to sweat, and that the water may drain off, for two or three days more, when it is spread abroad and dried in the sun; and when dry is put into troughs and pounded with rammers until all the husks (or parchment as it is called) are beat off, when it is winnowed in the air, and exposed in the sun until it is perfectly dry, and then sent to market.

At the close of the last century *Dominica* produced more than 2,000,000 lbs. of coffee annually, even in 1833 the shipments were 1,612,528 lbs., and in 1835 over 1,000,000 lbs., but the general effect of the negro emancipation was the entire abandonment of coffee cultivation by the owners, under whose care and energy they had hitherto been such brilliant mines of wealth. The estates were appropriated, subdivided, and allotted among the peasantry, who took up the production of sugar, cacao, cassava, and other cultures.

Production in America.—Having passed under review the several West Indian islands, I come now to speak of Central and Southern America, which are extensive and increasing fields of coffee production. The direct imports into the United Kingdom from the different States there have been as follows, in cwts.:—

Year.	Central America.	New Granada (U. S. of Colombia).	Venezuela.	Brazil.
1872	133,290	27,063	..	159,194
1873	197,720	16,866	10,685	143,749
1874	151,538	21,724	7,863	200,125
1875	210,979	14,646	2,162	222,375
1885	223,348	8,707	213	187,526
1886	235,191	19,163	405	203,325
1887	245,344	..	..	300,495
1888	229,543	..	..	160,258

From *British Honduras* we have received lately supplies of coffee, but whether this is all grown there, or partly Guatemala produce shipped from thence, I am unable to state. The direct imports from Honduras have been:—

		Cwts.			Cwts.
1872	..	2,635	1875	..	4,777
1873	..	1,626	1886	..	439
1874	..	3,975			

Costa Rica.—This republic has risen by the culture of coffee to a degree of prosperity unknown by the other Central American States. The introduction of the plant in the vast plain of San José, which it now covers, only dates back some forty years. The principal plantations belong to the families of Monteleagre and Mora.

About 1845 the distinguished Señor Mora, then President of the Republic of Costa Rica, prohibited the raising of plantains for sanitary and other reasons, and caused a governmental decree to be passed encouraging the culture of coffee. "With lingering steps and slow" the hill-sides about Cartage and San José were cleared and planted with coffee slips, and to-day a thousand coffee planters are enjoying a competency from the net income of the estates thus compulsorily established.

An impression which some have that American coffee is inferior to the eastern, as, for example, the Java and far-famed Mocha, is erroneous. On the contrary, the coffee raised on the highlands of Nicaragua and Costa Rica is unsurpassed for strength and a delicate aromatic flavour, unknown to the best coffee of the East; and the fruit of the lowlands and medium elevations is far from inferior. Although not having the plump form or peculiar bluish tinge which are the characteristics of the excellent coffee of the highlands, it compares favourably with the coffee of Java or the Moluccas. The cultivation of coffee will undoubtedly here engage the attention of many of the colonists. It is worth noting that, though in opposite quarters of the globe, Costa Rica and Southern India lie in the same position of north latitude, and that their respective growths approach one another in fine quality. This line also cuts directly through the Abyssinian coffee districts which of old supplied Persia.

The quality of Costa Rica coffee is considered excellent. The following figures show the exports at decennial periods:—

				Cwts.					Cwts.
1845	..	..	..	70,000	|	1865	..	..	99,720
1855	..	..	..	70,709	|	1875	..	..	210,000
				1883	..	..	..		20,005,927 lbs.

Coffee is and must be the principal and almost only staple product of Costa Rica, until a railroad enables it to compete with other countries in sugar, cacao, &c. The scarcity of labour is one great drawback, for in many parts crops spoil on the trees for want of hands to gather them.

Guatemala.—This republic lies on the 14th and 15th parallel of N. latitude. The frost line here is considered 5000 feet above the level of the sea. Coffee ought to be planted from 2000 to 4000 feet above sea-level in a moist free soil, and, if possible, a virgin soil. From 60° to 80° Fahr. is the proper climate for coffee, although it will grow in hotter countries and lower altitudes. Coffee blooms here during the months of April and May. Bloom on a coffee tree does not remain over twenty-four hours. A coffee tree carries its berry eight months before it is ripe. It is ready to gather in this country during the months of November and December. Coffee when ripe is exactly like a red cherry.

All coffee is gathered from the tree by hand—a slow and expensive method. No machine can ever be invented to pull coffee from the tree, as sometimes the berries will be the same size and close together, but one may be red and ripe, while the one just

beside it may be green and unripe. One hand can pull from the trees about 120 lbs. of ripe coffee in a day, which yields about 15 lbs. of marketable coffee. It is taken from the trees to the machine-house, where it is put through the pulper. In this machine it is separated from the outside skin, the bean being delivered by the machine in a tank filled with water, where it remains one or two days.

When washed in the tank it is spread out to dry on the *patio*, a level dry surface which is made purposely to dry coffee on. It is a piece of ground, levelled off and paved with stone, mortar being spread over the stone very smooth. The coffee is placed on this *patio* until it is dried, which takes about ten days' exposure in the sun. Some plantations dry their coffee with drying machines, which in some parts of the country is absolutely necessary owing to the continued wet weather during the coffee season.

When the coffee is dried, it is taken to the machine-house again to be cleaned and made ready for shipment. The most important point is to have your coffee well dried before cleaning, that is taking off the hull. Probably the best machine ever invented for cleaning coffee is called the Retrilla, of English manufacture. It is a simple and clumsy, but very efficient machine, being merely two iron wheels, or wooden wheels shod with iron, about four feet in diameter, which run in a trough, also lined with iron. The coffee is laid in this trough and the wheels run over it and clean and polish the coffee at the same time. The wheels are about seven hundred pounds weight and run about twenty revolutions per minute around a circle fifteen feet in diameter. The coffee is then taken to the ventilator, which is simply a fan similar to that employed in cleaning wheat, where the hull or chaff is separated from the bean. Then the coffee is taken to the separator, which is a wire cylinder eighteen inches in diameter and twelve feet long. The wires which form this cylinder are wound around it, commencing very close, only to pass dust, then gradually opening to the end, where they are wide enough to pass a full coffee bean. This is the last machine coffee goes through. It then passes to a table, on which it is spread and hand-picked by women and children, who separate the deformed and bad-coloured beans from the good. When this is done, the coffee is put in sacks, weighed and sewed, and shipped to its market.

The bad coffee season of 1882 was followed in 1883 by an abundant crop. Allowing 50,000 quintals for home consumption, the harvest seems to have been about 450,000 quintals, or about 20,089 tons. The greater part of the lands in the Republic suitable for coffee growing are now in full yield, and the supply of Guatemalan coffee has consequently almost reached its maximum. Many agriculturists, disheartened by the bad prices realised in 1882, and the failure of whole districts to bear good coffee, have turned their attention to other crops, chiefly sugar, indigo, and cinchona.

Guatemala produces some of the best coffee that is grown in any country. The kernel of the Guatemala coffee is small and plump, resembling the best quality of wheat, and not large. From the

plantation of Mr. José Guardiola, of Chocoma, there is sent to New York a grade of coffee surpassing in quality either Java or Mocha. Mr. Guardiola has introduced drying-machines of his own invention, which enables him to cure his coffee in wet as well as sunny weather, and has also patented a hulling and polishing machine, which he uses with great success on his extensive plantation. To the introduction of these machines is no doubt attributable the preservation of the delicious flavour and aroma of Guatemala coffee. The exports of coffee to Europe from the Central American States are shown in a previous table.

Some forty years ago considerable plantations of coffee were made in different parts of this State, but the culture was abandoned owing to the disturbances among the Indians. Of late years, however, it has been resumed, and is making good progress. The greater part of the plantations are situated in the neighbourhood of Coban. Coffee will be in future the principal article of export, and to an extent and importance scarcely yet to be calculated. In 1860 only 63 tons were shipped; in 1863 this had increased to 799 tons; in 1867 to 2000 tons. In 1882 the coffee exports were valued at 3,132,719 dols.; and in 1883 at 4,848,833 dols.

In *Nicaragua* coffee is grown in the Vallee Menier, the plantation of the great Parisian chocolate firm; in 1882, 7,300,000 lbs. were shipped from this State.

In the State of *San Salvador* a fair quality of coffee is grown; the exports in 1865 were to the value of £21,500, in 1873 about £215,000; and in 1882, 18,005,364 lbs. were shipped.

In the States of *Colombia*, formerly New Granada, the coffee grown is of excellent quality, especially at Ocamá and Ambalima, but the quantity produced is limited, and is chiefly sold for consumption in the country. Our direct imports into Great Britain from New Granada averaged 20,000 cwts. in the four years ending 1875. In 1880 coffee was exported to the value of £610,200, but in 1883 it was only half this amount.

In *Ecuador* attention has of late years been given to the culture, and a very superior quality of coffee is produced. In 1855 only 776 cwts. were shipped, but now a large quantity is exported. The crop of coffee in 1874 was 10,652 cwts.

British Guiana.—In 1752 the cultivation of coffee was commenced in Demerara, and one bag was exported; in 1761, 45 tierces of coffee were shipped, and in 1764, 211 bags. In 1796 the colony was taken possession of by the British, and in 1803, 9,954,610 lbs. of coffee were shipped; in 1823 the exports of coffee were 8,008,729 lbs. After this the culture began to fall off; comparing 1829 with 1839, there was a deficiency in the latter year of 2,139,430 lbs. of coffee. The gradual decline in production is shown by the following figures, giving the exports:—

							Lbs.
1830	..	..	..	..	..	..	9,472,756
1840	..	..	..	..	..	..	3,357,300
1849	..	..	..	..	..	..	100,550

After this it was given up for sugar, but of late years several abandoned coffee estates have been reclaimed. Coffee is grown principally in the county of Berbice, and the Liberian coffee has been planted with great success also on some estates.

In *French Guiana* coffee was at one time an important staple, the species grown being the Mocha variety, for the cultivation of which the country is especially adapted; it is now chiefly grown as a shade tree to cacao, annatto, and other crops, but a few Government plantations are maintained, there being about 350 acres under coffee. The average production, as shown below, is scarcely 50,000 lbs. a year. Although temporarily abandoned, the trees continue to thrive in a wild state, and may be reclaimed hereafter. They attain to a height of about fifteen or sixteen feet, with a circumference a few feet from the ground of thirty inches; they are rich in foliage, but do not flower; the coffee tree here also appears to be safe from the ravages of insects, whereas many other trees suffer vitally from this evil.

			Kilogs.				Kilogs.
1861	..	..	50,000	1870	..	..	60,079
1865	..	..	64,436	1871	..	..	57,433
1866	..	..	73,270	1873	..	..	40,250
1867	..	..	107,424	1874	..	..	40,028
1868	..	..	60,463	1885	..	..	17,000
1869	..	..	135,614				

In *Surinam* the produce is only about 500,000 lbs.

In *Bolivia* coffee is grown in the whole extent of the Yungas, and of forms and varieties not generally known; it is best when raised on the flanks of the mountains. In the plains the berry increases in size, but loses flavour; when grown on higher elevations it decreases in size, but improves in quality. The Yungas coffee is so highly esteemed that it is considered equal, if not superior, to Mocha.

Peru.—Coffee grows with extraordinary luxuriance in the mountain regions of Peru; the activity of its vegetation is wonderful; the branches are borne down indeed with the weight of the numerous berries.

Venezuela.—The best coffee grows in the cooler portion of the State, and the crop is gathered in October. The production is about 600,000 cwts. annually.

With respect to what may be considered as the yearly yield of coffee per tree in Venezuela, as compared with Brazil and Ceylon, its principal rivals in the staple, up to 1858, it was generally considered that the average might be put down at half a pound per tree; but since that period such has been the neglect of the plantations throughout the country, owing, in the first place, to the uninterrupted five years' war of the Federation up to the close of the crop of 1853, and to the subsequent state of anarchy and confusion prevailing, the scarcity of capital and labour, and the want of personal supervision upon the part of landed proprietors, that the yield may be said to have diminished by one-half, and thus the general average does not exceed a quarter of a pound per

tree. It may be remarked, also, that the coffee plant, though prolific, is most delicate and susceptible, requiring constant attention and careful cultivation, such as circumstances do not admit of its having bestowed on it in that country.

An intelligent American gentleman, many years resident in Brazil, and well acquainted with coffee cultivation in the province of Rio Janeiro, who visited Caraccas in 1869, informed the coffee growers that the general average annual yield of coffee for the past twenty years in Brazil had been 4 lbs. per tree, and upon the most carefully cultivated plantations as high as 30 lbs. per tree, whilst upon smaller estates of 200 to 300 acres, with 500 trees per acre, a regular yield of 10 lbs. was obtained. The coffee trees in Brazil are not shaded as they are in Venezuela, which ensures a larger yield, although lessening the duration of producing power, generally estimated at about fifteen years. Improved and more scientific culture would certainly give 2 lbs. per tree as the average in Venezuela, many isolated instances existing of that amount, and even of over 4 lbs. per tree having been obtained.

The exports of coffee from Venezuela have been as follows in the financial years:—

				Tons.					Tons.
1834-35	..	..	..	2,705	|	1864-65	..	..	12,796
1844-45	..	..	..	13,197	|	1874-75	..	..	35,721
1854-55	..	..	..	17,156	|	1882-83	..	..	49,079

Only a small quantity comes to England.

Statistics prove that the coffee plant will bear climatic extremes, and that it will thrive in localities differing as much as 20° to 30° in average temperature. It flourishes best on uplands and mountain sides, from 1500 to 4500 feet above the sea level, and the tropical belt between 25° north and 30° south of the equator. Coffee has now begun to be largely cultivated in Colima, a small state on the Pacific coast. A line drawn from the port of Vera Cruz to the port of Manzanillo would bisect Colima, and the coffee grown in this district has the reputation of being remarkably good. Cordova and Orizaba coffee is equal to that of Cuba, but the Colima is said to be superior even to the favourite Mocha. In Mexico, coffee culture is making great progress, and it is destined hereafter to be one of the main exports of that country.

Production in Brazil.—Coffee having been introduced into the French settlement of Cayenne, by La Motte Aignon, the governor, in 1722, a Brazilian subject, Palhetta, while on a voyage to that colony, managed, not without much difficulty, to bring to the city of Belem (Para) a few of the seeds of this valuable plant; in that province coffee trees were multiplied through the care of Agostinho Domingos, and others. A deserter, it is said, introduced the plant from Para into Maranhão about 1770. The judge, Joas Gualberto Castello Banco, appointed chancellor to the high court of the Relacas at Rio Janeiro, took with him with great care two small coffee trees during the vice-royalty of the Marquis de Lavradio, in the middle of the eighteenth century, when sugar and cereals constituted the great fountains of the wealth of the province of

Rio Janeiro. The two plants were by order of that notable statesman cultivated in a private garden in the neighbourhood of the convent of Adjuda, and in this manner those two small and humble trees in the course of one century became the first and most important branch of the public wealth.

Mr. Moke, a Belgian, is said to have been the first planter to carry on the systematic cultivation of coffee near the city of Rio, and enormous profits have resulted from the energetic efforts thus made.

The coffee tree having rapidly multiplied, extended itself then over dozens of miles, and was transplanted to Minas Geraes, San Paulo, Bahia, Ceara, &c.

Coffee is now the most important agricultural product of Brazil, and forms the principal staple of its foreign commerce. It constitutes more than half of all the supply of coffee to the world. The culture of coffee in Brazil is carried on more or less largely from the river Amazon to the province of San Paulo, embracing nearly 20° of latitude. From the coast to the extreme west of the province of Matto Grosso comprises 25° of longitude. The total area in which coffee can be cultivated is estimated at 2,000,000 square kilometres, of about 1090 yards. The area under actual culture in the provinces of Rio, Minas, San Paulo, Santos, Bahia, and Ceara does not exceed 50,000 to 60,000 square kilometres. It succeeds best generally between the 18th and 25th parallels. The principal producing provinces are Rio Janeiro, San Paulo, Bahia, Ceara, and Minas Geraes. The shipping ports are Rio, Santos, Bahia, and Ceara, the port of Rio exporting about one-half of all that is shipped.

Of the varieties of the coffee tree, no less than sixteen species are said to be indigenous to Brazil, an evidence of the suitability of the soil and climate for the culture, while Peru, Guiana, Mexico, New Granada, and other parts of the continent, have also indigenous species of the tree.

The following is the classification of Brazilian coffees which is made by the Agricultural and Commercial Society of Rio:—

Rio Coffees.—Andarahy, Brazilian Mocha, Botucatu, Leroy, Brazilian Ceylon, Maragogipe, Murta, Brazilian Bourbon, and the fourteen following qualities: Fine, Superior Nos. 1 and 2; first good Nos. 1 and 2; first regular (average), Nos. 1 and 2; first ordinary, Nos. 1 and 2; good, Nos. 1 and 2; second ordinary, Nos. 1 and 2; ordinary, No. 2, Escolha. These coffees are again subdivided into washed and unwashed.

Santos Coffees (San Paulo).—The same varieties as Rio.

Capitania Coffees.—Those of the province of Espirito Santo.

Minas Geraes.—The same varieties as Rio, from which port they are all shipped.

Bahia Coffees.—Bahia, Caravillas, Muritiba, Valenca, Maragogipe, and the fourteen varieties of Rio.

Ceara Coffees.—The fourteen varieties of Rio.

The coffee plant grows in most parts of Brazil, as the medium temperature which it requires is found throughout nearly all the

empire. It prospers even in places exposed to the cold, and appears to vegetate with more vigour, but the fruit is not so abundant, nor has it the precocity and regularity necessary to render the crop profitable. As the flowering and fructification take place at two periods, the end of September and October, two gatherings are necessary.

Attempts have been made, but without any resulting benefit, to acclimatise some of the esteemed varieties from other countries. The Government introduced Bourbon plants in 1857, and Java, Mocha, and other species tried have soon degenerated and assimilated to the ordinary Brazilian. The same occurred in Martinique, where the Mocha coffee was introduced in 1818, for in a few years the berry was found not to differ from that ordinarily cultivated in the island.

When a plantation has to be made, the sunny slope of a hill is selected, the site of which is not too retentive of the water falling on it. This, after being cleared and burnt off in the usual manner of treating timber lands, is planted over in rows, with year-old plants previously reared in a nursery. These receive little further care than to keep the weeds down, and to have the upward growth checked by pruning, so as to facilitate the gathering of the crop. In four or five years the trees are productive, and will in general continue so for upwards of twenty years. Its thick clusters of white flowers burst forth in abundance at certain seasons, but the dark green foliage is rarely seen unrelieved by them, and by the fruit in all stages of maturity.

The pulp of the cherry that surrounds the bean is sweet and agreeable to the taste, and, like the leaves, partakes of the flavour of the berry.

From its strong flavour Brazilian coffee is improved by age, perhaps to a greater degree than any other coffee, and it is said, if kept for ten or twelve years, would fully equal the best Mocha.

It is essentially necessary that, during the drying, the berry does not come in contact with the earth, which would much injure its quality, hence in large plantations paved terraces are formed, or of some other materials. On smaller estates the coffee is dried on bamboo frames or some other substitute. As the paved or stuccoed drying terraces are expensive, it is better when possible to employ pulping machines, although these require a fall of water to work them. When the coffee is dry it has to be deprived of its pulp and parchment. The machines employed for this purpose have not much effect on the produce. It is simply a question of time and trouble, more economical than industrial. In fact, nothing can be imagined more simple and primitive than the appliances used in some of the countries which furnish the coffee most esteemed in the European markets.

Of late this has been carried out mechanically by the process of two Brazilian engineers, Messrs. Taunay and Telles, who have invented a drying apparatus bearing their name.

The berries of the ovoid form of the Mocha found in the markets are derived from the older Brazilian coffee trees, and from the higher branches of the young trees which are more exposed to the

solar rays; these are separated by bolters. In Brazil coffee trees are reckoned to yield, from their fifth to their twentieth year, an average of an arroba, or 32 lbs. of clean coffee to each ten trees. From six to twelve years the produce is commonly two, and sometimes three, arrobas to ten trees, but from the sixteenth to the twentieth year the crops are irregular, and below this average. The common yield of clean coffee is about one arroba to three bushels of the fresh fruit. An arroba of clean coffee is obtained from one and a third arroba of dry coffee in the hull, deprived of its pulp, but not of the parchment-like envelope. Whilst the cost of clearing, planting, and bringing into bearing an estate of 150 acres, with only 333 trees to the acre, is far more than that of a similar plantation in Ceylon, the returns are much larger per tree, averaging nearly 10 cwts. to the acre, and the trees bear much longer.

The productive duration of the coffee tree varies in different localities. At Rio and Santos it is from fifteen to twenty years; at Minas twenty to thirty years; at San Paulo twenty-five to forty years. The number of coffee trees in the empire was estimated in 1883 at 1,000,000,000, and the crop of coffee at 400,000,000 kilogrammes yearly. New plantations on a large scale have lately been made in San Paulo and Minas, so that the production is likely to be maintained.

The average annual increase in thirty-five years of coffee has been 2.86 per cent. From the port of Rio 55 per cent. of the Brazilian exports pass, and coffee makes up half the total value.

Brazil well merits the name of the coffee country *par excellence*, inasmuch as it ships about half the whole coffee produce of the world.

In 1817 it shipped 66,985 bags; in 1820, 97,498; in 1830, 484,222; in 1840, 1,037,981; in 1876, 3,756,122, and now about 6,000,000 bags of 140 lbs.

In 1884, out of 660,000,000 kilogrammes, Brazil produced 360,000,000; and yet in 1800 it only exported thirteen bags of coffee.

The coffee is chiefly divided into eight kinds, which take the names of the districts in which it is cultivated, viz., Rio, Santos, Bahia, Ceara, Minas-Geraes, Andarahy, Pernambuco and Amazon.

In Brazil virgin soils and wooded lands are sought out for a plantation. The trees are felled and burnt on the spot, and the coffee trees are planted, and left to themselves, care being taken to protect them from the fierce rays of the sun and any cold winds. The coffee succeeds well in Brazil between the 18th and 25th parallels. At the end of five or six years the plantation is in full bearing. The fruit ripens in four months and the harvest goes on almost without interruption.

An hectare (nearly $2\frac{1}{2}$ acres), well planted (918 trees), will yield on an average 2 tons in first-class soils, $1\frac{1}{2}$ in second-class grounds, and less than $\frac{3}{4}$ of a ton in inferior soils.

With reference to the prospects of the Brazilian coffee trade during this year, the *Rio News* makes the following remarks:—"Estimates are furnished us of the 1888-89 crops, and these vary from 4,500,000 to 6,000,000 bags for Rio, and 2,750,000 to 3,500,000

bags for Santos. Opinions that we consider reliable fix the first at 5,000,000 bags, and the latter at 3,000,000 bags. This is a very large supply, and must mean low prices in consuming markets. It seems certain that the number of slaves will be much reduced, but the flow of immigration to the province is satisfactorily increasing, and we do not suppose that there is any particular reason why a colonist or immigrant should not gather coffee as well, if not better, than a slave."

The coffee produced in Brazil in 1881 amounted to about 5,000,000 bags of 120 lbs. each, making a total of 5,357,143 cwts., or more than half the world's consumption, which is estimated at about 500,000 tons. Of this quantity there was exported to the United States of America 2,241,976 bags, and to Europe, &c., 2,135,442 bags. When the emancipation of the negroes is complete, as it will be in another ten years, the question is whether the coffee planters will be able to find labourers enough to keep up this high total.

The quality has been so much improved of late years that much of the coffee is sent to Europe and sold under the names of Java, Ceylon, Martinique, San Domingo, and even Mocha. At the Paris International Exhibition of 1867, Brazilian coffee received from the jurors a gold medal over all other coffees.

Between 1816 and 1820 the planters of Rio abandoned the culture of the sugar-cane, and turned their attention to coffee, the cultivation of which thereafter became the basis of immense progress, and the accumulation of much wealth in the capital of the empire.

The greater part of the Caravillas coffee from the province of Bahia is sent to Rio Janeiro in consequence of the easy transit during the summer months, when the prevailing winds from the north-east enable the planters to get quick returns for their produce from that important coffee mart.

Campinas is the coffee capital of the province of Santos, and the quantity carried over the San Paulo line was, in 1871, 41,107 tons.

The culture of coffee is comparatively recent in the province of Ceara, but it is being carried out on a large scale in the mountains of Maragogipe, Aratana, Baturite, Araripe, Machado, and Urburotama. The abolition of the duty on coffee in the United States, and its reduction from 3*d.* to 1½*d.* a pound in England, came as a timely relief to the Brazilian planter.

The quarters to which Brazilian coffee is shipped may be divided into three classes—1, the United States; 2, Northern European and Channel ports; and 3, Mediterranean ports. The relative proportions to each are shown by the following exports in bags, the first column, for 1871, from Rio only:—

	1871.	1883.
United States	1,354,346	2,314,650
North Europe	689,917	724,986
Mediterranean	198,498	307,506
Different ports	115,243	307,368
	2,358,004	3,654,511
From Santos		1,898,638
		5,553,149

As the United States monopolise the chief supply of Brazilian coffee, it may be interesting to note their aggregate imports of all kinds, which have been as follows, in decennial periods:—

	Lbs.		Lbs.
1790	4,150,754	1840	94,996,095
1800	7,408,196	1850	144,986,895
1810	5,352,082	1870	282,540,737
1820	13,291,857	1880	446,851,000
1830	51,488,248	1886	564,708,000

The American consumption is about one-fourth of the entire world, and more than any other country on the globe.

The United States receives 74 to 80 per cent. of its supplies from Brazil. Its total consumption in 1886, including the Pacific States, was over 282,000 tons, the largest in the history of the trade.

Of the Brazil coffee crop the United States have taken in the last twelve years the following quantity:—

	Bags of 60 kilos.		Bags of 60 kilos.
1876	1,448,424	1882	2,459,132
1877	1,710,073	1883	2,314,650
1878	1,670,383	1884	2,430,620
1879	2,283,545	1885	2,620,300
1880	1,886,857	1886	2,933,600
1881	2,241,976	1887	2,701,000

DESTINATION of the COFFEE SHIPPED from RIO ONLY, in the YEARS ENDING DECEMBER, in SACKS of 60 KILOGRAMMES.

	Year.	Europe, &c.	United States.	Total.
	1876	1,317,498	1,448,424	2,765,922
	1877	1,136,482	1,710,073	2,846,555
	1878	1,360,816	1,670,383	3,031,199
	1879	1,251,638	2,283,545	3,535,183
	1880	1,676,197	1,886,857	3,563,054
	1881	2,135,442	2,241,976	4,377,418
	1882	1,741,458	2,459,132	4,200,590
	1883	1,339,861	2,314,650	3,654,511

BRAZIL—EXPORTS of COFFEE, in BALES of 60 KILOGRAMMES (about 1½ cwt.).

Years ending July 1.	Rio.			Santos.			Bahia.
	To North America.	To Europe.	Total.	To North America.	To Europe.	Total.	Years ending Oct. 1.
1877-78	1,501,400	942,800	2,549,900	99,600	854,000	1,019,500	79,200
1878-79	2,073,400	1,325,200	3,577,800	177,300	987,200	1,187,400	93,900
1879-80	1,875,300	920,000	2,937,000	194,100	830,100	1,046,100	134,300
1880-81	2,098,700	1,907,300	4,324,500	239,800	971,800	1,228,300	126,900
1881-82	2,284,100	1,333,600	3,880,900	238,000	1,306,900	1,555,000	145,900
1882-83	2,606,300	1,656,700	4,509,900	329,500	1,532,100	1,874,600	108,800
1883-84	2,010,420	947,800	3,198,000	420,200	1,491,800	1,936,500	91,600
1884-85	2,144,600	1,250,800	4,209,200	475,700	1,684,100	2,171,500	121,000
1885-86	2,456,400	1,050,800	3,712,400	477,200	1,181,600	1,666,500	208,000
1886-87	2,134,200	1,217,200	3,483,900	566,800	1,955,500	2,527,700	150,000

OTHER AMERICAN COFFEE—EXPORTS to EUROPE and UNITED STATES, in BALES of 60 KILOGRAMMES (or 1½ cwt.).

Year.	Mexico and Central America.	Venezuela.	West India Islands.	Haiti.
	Costa Rica, Guatemala, and New Granada.	Laguayra, Porto Cabello, and Maracaibo.	Cuba, Porto Rico, and British West Indies.	
1878	407,800	672,300	88,700	473,600
1879	529,500	550,000	175,300	495,200
1880	660,300	678,100	138,900	498,600
1881	767,000	647,000	200,000	546,000
1882	842,000	846,000	186,700	452,400
1883	885,400	729,000	205,000	536,000
1884	870,900	617,000	170,000	385,000
1885	1,035,000	637,000	230,000	660,000
1886	928,000	700,000	190,000	475,000
1887	1,066,100	632,200	163,100	400,400

EXPORTS of COFFEE from the PORT of RIO.

	Bags.		Bags.
1800	10	1860	2,127,219
1820	97,400	1870	2,209,456
1830	391,785	1880	3,563,054
1840	1,068,418	1885	4,209,200
1850	1,343,484	1887	3,483,900

The Bahia bag contains 120 lbs. ; the Rio bag 160 lbs.

BRAZIL—EXPORTS of COFFEE, in BAGS of 60 KILOGRAMMES.

Year.	Rio.	Santos.	Total.
1873	2,433,709	542,569	2,976,278
1874	2,673,281	666,943	3,340,224
1875	3,152,296	826,382	3,978,678
1876	2,765,922	754,993	3,520,915
1877	2,846,555	628,903	3,475,458
1878	3,031,199	999,007	4,030,206
1879	3,535,183	1,260,172	4,745,355
1880	3,563,054	1,042,246	4,605,300
1881	4,377,418	1,204,198	5,581,616
1882	4,200,590	1,936,500	6,737,090
1883	3,654,511	1,898,638	5,553,149
1887	3,483,900	2,527,700	6,011,600

Besides the above, Bahia and Ceara ship about 12,000 tons.

In the *Pacific Islands* some attention has been given to coffee culture. Large plantations of coffee trees were made at Tahiti in 1862, with the view of supplying Chili, California, and Sydney. In 1868, 78,373 lbs. of coffee were shipped from the Hawaiian Islands. In later years from Hawaii there was shipped of coffee:—

1880	100,000,000 lbs.	1882	8,000,000 kilos.
1881	19,000,000 „	1883	16,000,000 lbs.

Fiji.—Perhaps no tropical industry offers more genuine attractions to a man possessed of ordinary business ability, with a taste for agricultural pursuits, than does that of coffee-planting.

In even the most unhealthy of tropical countries, coffee-planting, from its having to be conducted at a considerable elevation above sea-level, is, as compared with the majority of tropical pursuits, regarded as a peculiarly salutary and agreeable occupation. In Fiji, however, the exceptionally healthful character of the country obviates the institution of any such comparison.

The coffee industry is no longer in its infancy in Fiji. Questions with regard to soil, natural fertility, elevation, and shelter, having now been proved by the experience of pioneer planters, may be regarded as settled, and any one now opening up a coffee plantation in Fiji need no longer run the risks attending experiment in these directions.

That the country is one specially adapted to the growth of the coffee plant is attested by Mr. John Horne, F.L.S., Director of the Botanical Gardens, Mauritius, who, in his 'Remarks on the Agricultural Prospects of Fiji,' writes as follows:—

"In Fiji there is a large extent of land, which from a variety of causes is better adapted for growing coffee than any other tropical product. The greater portion of this land lies in the interior of Viti Levu, Vanua Levu, Taviuni, some portions of Rabi, Ovalau, &c. These islands contain large areas of almost incomparably fine coffee land, and enjoy a climate which is at once healthy and well adapted for the growth of the coffee tree, plant, or bush. Next to sugar-cane growing, that of coffee will in future years claim a large share of attention. Coffee growing will yearly extend and become an important product of those islands. Coffee will be second to none except sugar in value; its export value will ultimately attain to about a million and a-half or to two millions sterling per annum. The plants of coffee seen in the interior of Viti Levu, Vanua Levu, and Taviuni were remarkably healthy looking; indeed, the healthy appearance of the plants prove that coffee will succeed in Fiji beyond a doubt."

The peculiarity of the country in this respect is manifested in the matter of altitude, which differs materially from that necessary in other countries. Experienced planters from Ceylon say that 1000 feet in Fiji is equal to about 3500 feet in Ceylon, while coffee on the coast lands yields well, but gives a smaller berry.

Cultivation in other respects varies very little from that pursued in other coffee-producing countries, but great regard ought to be paid to the shelter afforded to the plantation from the south-east trade winds, and no shade trees ought to be left, as coffee does better in the open.

Seed, when planted in the ordinarily careful way, quickly germinates, and the seedlings are fit for use in seven months. If planted out in October or November it will yield a maiden crop of four cwts. per acre in about two and a half years, while it has already been proved that almost any weight up to fifteen cwts.

per acre may be picked in successive years according to variations in climate, soil, and weather.

Wide planting, too, will be found advantageous, but the distance ought to be regulated by the rankness of the soil, which, being in many places volcanic, causes the primaries to overlap in the third year when planted six feet apart.

Topping, likewise, must be regulated by position, and in well-sheltered places five feet is not too high to allow, especially where the soil is volcanic.

Handling and pruning, if taken in time, will require only ordinary attention, but must on no account be neglected.

Buildings of a substantial character can be erected at a moderate cost, fine hard wood being plentiful in the jungle, and easily sawn by Polynesian or other labour, on the estate, while lime is made from the coral which abounds on the coast.

The coffee-leaf disease, which some four years ago threatened to crush the coffee industry throughout the world, may now be said to have all but disappeared from Fiji.

Experience has shown that it may best be resisted by high cultivation, and for this purpose the incomparably rich soil of the group offers facilities that cannot elsewhere be met with.

On the Island of Taviuni, for instance, which, on account of position and fertility, seems to have been specially selected as a field for the coffee industry in Fiji, the disease is rarely to be met with. Of this island Mr. F. B. Thurber, in his 'Coffee from Plantation to Cup,' remarks:—"In the Island of Taviuni in the Fiji group there are some half-dozen coffee estates, ranging in area from fifty to three hundred acres. Coffee trees are just coming into bearing (1880). At the Sydney Exhibition the first gold medal was awarded to an exhibit of coffee from Fiji."

On the Island of Taviuni is also erected the principal curing mill in the Colony. The site is a dry one, fully exposed to the sun. Extensive drying-grounds, and upwards of 3000 square feet of wire-netting on reapers are provided for drying and preserving the coffee. The capacity of the mill is a turn-out of 2400 lbs. of clean coffee per hour.

The following figures show the quantities of coffee exported during five years:—1881, 104,524 lbs.; 1882, 62,328 lbs.; 1883, 210,204 lbs.; 1884, 86,065 lbs.; 1885, 85,239 lbs.

India.—The coffee grown in the Madras Presidency is brought down the Ghats from the hill districts of Mysore, Coorg, Wynaad, and the Nilgiris, to be exported from the Malabar ports. Some is also shipped in South Canara and at Tuticorin, as well as from a new port in Travancore. The exports from the Madras Presidency do not show an increase, but much is consumed locally.

The shipments have been as follows:—

			Lbs.				Lbs.
1871	..	..	31,295,195	1874	..	..	40,110,203
1872	..	..	52,047,318	1875	..	..	33,738,922
1873	..	..	39,781,819	1885	..	..	37,581,894

The coffee fields in Travancore may be divided into the northern, middle, and southern districts. The northern includes the estates at and about Peremade; the middle, those near and to the north of the Augustan Peak, and in the neighbourhood of Courtallum; the southern, called also the Assamboos range, includes those between Assamboos in the south and the Koday river in the north. In the latter districts there are coffee estates covering 10,000 acres, of which 5500 acres are planted, and all this has been done since 1863.

The number of coffee estates owned by Europeans in Travancore in 1870 was fifty, containing in the aggregate about 14,700 acres. This was independent of the estates and gardens owned by natives, both on the hills and plains. Since then a good many hundred acres of forest land have been planted with coffee.

The average annual exports of coffee from India since 1850 are shown below in periods of five years each:—

Years.	Lbs.	Value.	Years.	Lbs.	Value.
		£			£
1851-55	7,813,602	94,974	1871-75	41,405,214	1,218,867
1856-60	8,274,183	135,263	1876-80	37,577,984	1,496,341
1861-65	24,162,260	555,652	1881-85	39,732,985	1,424,741
1866-70	33,879,096	784,727			

COFFEE EXPORTS FROM INDIA.

			Cwts.				Cwts.
1876	..	..	371,986	1882	..	..	351,981
1877	..	..	304,158	1883	..	..	364,008
1878	..	..	298,587	1884	..	..	364,410
1879	..	..	342,268	1885	..	..	342,682
1880	..	..	361,037	1886	..	..	376,702
1881	..	..	370,713	1887	..	..	370,458

This is nearly all shipped from the Port of Madras, and only about 30,000 cwt. from Bombay.

In 1883-84, 185,839 acres were returned as being under coffee for all India. The total yield was 30,750,000 lbs. In 1885-86 the land under culture was reduced to 119,142 acres.

The coffee plantations in India and our Colonies are threatened with annihilation by external competition, chiefly from Brazil. The failure of the coffee estates is a serious matter. In Coorg they gave permanent employment to 27,000 people, and another 20,000 in temporary work during the picking season.

Much of the Indian coffee goes to Arabia, Persia, Egypt, Turkey in Asia, and even to Mauritius. Ceylon and the Straits send to India large quantities of coffee.

The following table shows the destination of Indian coffee in the last three financial years ending 31st March, in cwts. :—

Countries.	1885.	1886.	1887.
United Kingdom	172,563	197,247	193,501
Austria	1,598	4,355	5,640
France	117,120	110,213	119,677
Egypt	4,657	9,346	12,018
Arabia	8,084	17,413	9,630
Persia	10,475	12,603	8,135
Turkey in Asia	10,266	9,619	8,707
Other countries	3,554	10,231	13,155
	328,317	371,027	370,458

The coffee tree is supposed to be indigenous to the highlands which border on the African coast of the Red Sea; possibly the district called Kaffa, to the south of Abyssinia, gives us a hint as to its origin. Hence it was imported into Arabia, to the hilly districts of Yemen or Arabia Felix. This is supposed to have been effected in the 14th century, from which time dates the importance of Mocha as a trading port.

It may be assumed that the coffee plantations of Yemen increased until the yield served for export as well as home consumption. In the 16th century mention is made of the consumption of coffee by the Turks, and Lord Bacon, among other writers, alludes to it.

The coffee came by ships from Mocha to Suez, and overland by caravans to Damascus and Aleppo, the total exports from Mocha, in the middle of the 17th century, being estimated by Dufour at about 16,000 bales of 300 lbs. each, or about 2,150 tons.

Mr. Ellis, F.R.S., in his account of coffee, published long ago, observed that the part of Arabia from whence the Asiatic coffee is brought, is for the most part extremely sandy, dry, and hot. At Batavia the soil is in general wet and deep; and though, like other eastern climates, there is a dry season, yet in the rainy periods the quantity of wet that falls is excessive. The rich, luxuriant state of vegetation in the island of Java, on which Batavia is situated, is a proof of this assertion; and one may safely infer that a plant brought from a dry, sterile, sandy soil, will assume not only a very different appearance, but its fruit will have a very different quality from that which is the produce of a fertile, moist soil, subjected to equal heat. The drier the soil on which the coffee grows, the smaller is its fruit, and its quality more excellent.

It is certain that in old coffee trees the fruit is smaller; perhaps an accurate taste would discover that its flavour is improved in proportion.

Arabia.—Before leaving the Asiatic continent, we must say a few words in passing on the coffee production of Arabia.

For ages before its use among the western nations, coffee was raised on the famous hills of Yemen, in Arabia, where Niebuhr states the tree was first cultivated after it was brought from Abyssinia by the Arabs. The coffee gardens there are on terraces, which reach an elevation of about 3000 feet. The soil is kept moist by means of small artificial canals, which are made to irri-

gate the whole by the water falling from the upper to the lower terraces. The trees are planted so close together that the thick foliage shelters their roots from the tropical heat of the sun. The fruit begins to ripen in February, but the most considerable harvest is in May. When the berries are dried and prepared, they are conveyed to the city of Beit al Fakih, when part goes to Mocha and the rest to European markets.

From Mocha, Hodeida, and other parts of Arabia, there used to be exported, a quarter of a century ago, about 10,000 tons of coffee annually, but it is difficult to get at any precise figures as to the production now; it certainly, however, is not one-half of this.

The principal coffee districts are Hinjersia, Tarzia, Oudein, Aneizah, Bazil, and Wusaf. The coffees of the Red Sea are mostly sent first to Bombay by Arab ships, and there garbled and forwarded to Europe. Mocha coffee, until lately, has been much esteemed; the fine sorts continue to be so, but the major part imported into this country is of a very mixed character, in many cases stones and husks forming a good portion of the bulk. Other growths, such as Mysore and fine East India, are rapidly superseding this kind, and unless the quality is much improved the demand in this country must die away; as it is, the greater part is exported at prices actually below those of Plantation Ceylon, and other colonial growths. The berry of the really choice qualities of Mocha, when roasted, has a flavour and fragrance which are unequalled by other growths.

Africa and the African Islands.—The eastern and western coasts of Africa, including the islands of Reunion, St. Helena, St. Thomas, and Prince's, produce coffee to the extent of about 2,000,000 lbs. yearly. The island of St. Thomas is progressing in coffee production. At Praia Rei, where the culture was commenced in 1854, the produce has gone on advancing. This property, which is one league and a half by three in extent, is divided into three estates, cultivated by about 300 labourers; Monte Cafe, another estate commenced in 1854, by 50 labourers, in the course of eight years had nearly 500,000 trees planted. The seventh year the crop yielded 200,000 lbs., and since 1865 has produced about 550,000 lbs. annually. Alta Dourro, another estate, only commenced in 1857, had planted some 50,000 trees in a year or two, and is now a most productive property. The coffee of Liberia and Rio Nunez has a high reputation.

Although attention was prominently drawn by me to the excellence of the Liberian coffee, and its prolificness in the first edition of this work nearly half a century ago, it is only within the last ten or twelve years that planters and commercial men have begun to duly appreciate its value and importance.

Coffee is also grown in the Cape Verde islands, Mozambique, Madagascar, Angola, the Gold Coast, Gaboon, Ambriz, and Madeira. About the villages and settlements of the Sherbro river and Sierra Leone wild coffee trees are very abundant.

There are many varieties of West African coffee from the large and symmetrical pale berries of St. Thomas to the little dark

Bembé coffees. In the Congo State, the production of coffee in 1887 was 2,750,000 lbs.

Bourbon or Reunion.—This island was taken possession of by the French in 1649. In 1715 wild coffee trees were found growing in the woods, and in 1718 Mocha coffee trees were introduced.

The former reputation of Bourbon coffee was European, and the island long owed its prosperity to coffee culture, but the hurricanes, decay of the trees used for shade, and the preference given by the planters of late years to sugar cultivation, has caused a great decline in the production of coffee. In 1817 the crop exceeded 7,250,000 lbs., but in 1860, only 530,000 lbs. were shipped, in 1865 less than 470,000 lbs., and in 1875, 467,500 lbs., although in the previous year, 1874, it was 719,400 lbs. The land under cultivation with coffee is only 5200 acres against 121,000 acres under cane, and there are 347 coffee works or buildings. There are five species or varieties of the coffee shrub, known on the island, viz. :

1. Mocha, passing as Bourbon (*Coffea Arabica*), the first introduced into the island, and superior to all other kinds, easy to grow, but requiring shade trees for shelter.

2. Leroy coffee (*Coffea laurina*), the Sierra Leone species, a hardy kind, growing readily without shade, and having a seed pointed at one end.

3. Myrtle coffee, a Mocha variety of *C. Arabica*, especially remarkable for the longevity of the tree.

4. Aden coffee (*Coffea microcarpa*), with small regular berries, and a particular aroma, brought from Hes, Yemen, by Admiral Jehuine; it is the same as the Foucard coffee of Guadaloupe; very little of this variety is, however, grown in the island.

5. Bitter or wild coffee (*Coffea Mauritanica*), an indigenous species, common in the elevated forests of the island, with a pointed seed of a strange form, having a strong and bitter flavour, which intoxicates in infusion, but mixed with other kinds is agreeable.

Liberia.—Coffee is found in a dwarfish state growing wild in all parts of the republic of Liberia, on the west coast of Africa, and is believed to be a distinct species, which has now been named *Coffea Liberica*, but used to pass as *C. microcarpa*. Some suppose it to be indigenous, others that it was introduced by the Portuguese a few centuries ago. The coffee now being cultivated in Liberia is from plants originally procured from the forest, but greatly improved by cultivation. It is grown both on light alluvial soil near the coast, and on gravelly soils in the interior. From present indications in a few years the export of coffee from Liberia will be considerable, and its rich and superior flavour will secure for it a corresponding demand at remunerative prices. Coffee it has been proved can be cultivated with great ease, and to any extent, in this republic, from being indigenous to the soil and the tree being found there in abundance. A single tree at Monrovia, it is said, has yielded the enormous quantity of 16 lbs. at one gathering. It was estimated some years since that there were about 30,000 coffee trees in one of the counties, that of Grand

Bassa, and the quality of the produce was stated to be equal to the best Java. About the villages and settlements of the Sherbro river and Sierra Leone, wild coffee trees are very abundant. A good many plants of Liberian coffee have been sent lately from Kew to Jamaica, Southern India, and Ceylon.

In this Republic the coffee tree is grown in all varieties of soil, but prospers most in those of a loose nature, such as the sandy and loamy soils, especially if these are strengthened by the addition of rocks. There are two species of sandy soil in Liberia; one has been the bed of the sea, and this has not been enriched by decayed vegetable and other matter, but has near the surface a substratum of clay. This serves as a reservoir to hold the surplus water, which rising through the sand by capillary attraction, keeps plants growing even in dry weather. This soil is particularly suited to coffee, which grows rapidly in it.

Two systems of hulling the coffee are practised in Liberia; one consists in taking off the cherry hull when fresh from the tree, drying the bean, and then denuding it of its parchment; the other in drying the entire berry, and taking off both hulls by one manipulation. The former method is the more expeditious, but by the latter there is an improvement in the quality of the coffee, as the beans having been thoroughly dried in both hulls, the aroma is prevented from escaping, and it is also said that there is a gain in the weight of the bean.

The plant producing Liberian coffee is distinguished from the ordinary coffee tree (*C. Arabica*), by its more robust habit, its larger leaves, and much larger berries and seeds. Liberian coffee grows equally well in the neighbourhood of the sea, and at considerable distances from it. Under like conditions of soil and attention, trees near the sea shore in Monrovia, are about the same as those at Careysburg and other places thirty miles distant. The wild coffee from which the cultivated comes, is found at even still greater distances in the interior. At Bassa and Sinou the coffee trees are said to grow within a hundred yards of the sea. The general temperature at which coffee thrives best ranges from 72° to 87° Fahrenheit in the shade. In the country, at the furthest point at which coffee is cultivated by the settlers, there is a difference of one or two degrees lower, owing principally to the rise in the land. The lowest temperature observed at Monrovia, near the sea, was 62°, at seven o'clock A.M., in the month of January, during the prevalence of Harmattan winds, the highest temperature being 91°, but these are exceptional cases. Along the coast the coffee tree thrives, at only a few feet (about ten) above sea level. At Careysburg and at Mount Coffee, it succeeds as well at an elevation of 550 feet. It grows equally well on level ground as on slopes. In the former situation, however, care should be taken not to allow water to stand; and in the latter the rich mould or surface soil should not be washed away.

The method of cultivation practised in Liberia is similar to that adopted in the East Indies. The forests are cleared in the same manner; the undergrowth is first cut, then the large trees are

felled, lopped, and when sufficiently dry, the whole is set on fire. The stumps of the trees are, as a rule, immediately removed. The entire ground is not ploughed, but holes are dug at proper intervals for the reception of the plants. These are generally not less than 12 feet apart, and are dug in straight parallel lines. Ploughing, by loosening the soil, would, on sloping land, render it liable to be washed away by the heavy rains. The plants are taken from the nursery when from a year to two years old, and in planting the cherry hull is removed, and the seeds are deposited in rows from two to three feet apart. The seeds are inserted in the ground at a depth of about one inch, if the showers be regular, but at a depth of two inches if the weather is dry. The transplanting is generally done at the beginning of the rainy season, in May or June. The trees are lopped at the height of 5 feet; but this rule is not observed by all growers. After the trees are lopped, they shoot out a number of suckers from the trunk. These are generally pulled out by hand, and no secondary shoots are allowed to grow on the branches nearer to the trunk than 18 inches. This would give an open space of three feet in diameter, in the centre of the tree, for the penetration of sunshine, and the circulation of air. This Liberian coffee tree does not produce all its flowers at one blooming, the time of blossoming depends upon the occasional showers that fall in the dry season, for although the buds may stand out prominently, they will remain without opening for a space of two months, or until there falls a shower of rain sufficient to saturate the soil; a light shower which does not soak into the ground will not cause them to open. In December a slight blossom appears, and the fullest blooms appear in January and February. There is only one full crop, and this is gathered during the months of December, January, February and March. Surface manuring is the best suited to Liberian coffee trees, as these belong to the class of forest trees whose feeders keep near the surface. Even when the manure is placed in trenches the fibrous roots or feeders penetrate it, and seek the surface long before the manure is consumed. Coffee pulp, mixed with other ingredients, guano, ashes, and clay from the hill nests of the termites are also extensively used as manures to promote the growth of the tree.

Wild trees are found in the forest more than 30 feet high, and 10 to 12 feet in diameter. This coffee tree is confined strictly to the sections of country between 4° and 7° north latitude. It has been found wild from the sea shore to the part where the mountainous or hilly land descends into the grassy plains on the borders of the Mandingo country. Here the Liberian coffee apparently stops.

In size the berry both of the cultivated and the wild Liberian coffee exceed that of any other known variety. Some berries from a wild tree in a section of country beyond Careysburg about 40 miles from the sea were found to be one-third larger than any hitherto discovered. As a rule the berries are entirely red when ripe; but some are red on one-half and yellow on the other. Some are red, or red on one half and green on the other. Others

when ripe are entirely green on the outside, but have the blood red colour on the inside of the first hull. Others, again, are entirely yellow.

The Liberian coffee industry is attaining very considerable importance, and the quantity exported largely increasing every year. In 1878 only 200,000 lbs. of coffee were exported. In 1881 300,000 lbs. were shipped, nearly all to the United States.

Different estimates have been given of the production of the Liberian coffee trees. It has been stated that if properly cultivated they ought to average 3 lbs. when ten or twelve years old, but the trees, owing to lack of means to give them the high cultivation which they require, do not produce on an average one-third of the quantity they are capable of producing. A Ceylon coffee planter of thirty years' experience, estimated that the production of an acre of Liberian coffee would, under favourable circumstances, equal that of ten acres of Ceylon coffee. The produce of an acre of Liberian coffee trees ten years old, properly cultivated, may easily be set down at 1500 lbs.

Distinct varieties of the plant are known, one of which produces fruit at an earlier age than the other; the berry also is smaller. The larger variety, however, is preferred, as yielding a superior quality of coffee, and a larger crop. This larger variety again varies in itself under changed conditions of soil. In the moist lowlands the berry is very large, while in the dry rocky hills or uplands, it becomes somewhat smaller, but of a finer flavour. The trees on a single plantation produce berries varying in size to some extent. The small variety before referred to, begins to bear at eighteen months, the larger form in the third year; this variety has, however, been known to bear sooner. The first crop is usually only a few berries, but the tree goes on increasing until it becomes capable of yielding 20 lbs., and some very old trees have been known to give 24 lbs. each, but more generally depends upon cultivation than upon age.

For pulping Liberian coffee a very useful hand-pulper has been invented by Messrs. John Wather and Co., Colombo, Ceylon. It is said to pulp at the rate of ten bushels per hour, and to cost, complete, £18. Another machine adapted for hulling this coffee in the cracknel state, that is, after the cherries have been simply dried in the sun (without pulping), is highly recommended by Mr. E. S. Morris, of Philadelphia, who has taken a great personal interest in the development of the coffee industry amongst the negroes of the Liberian Republic.

It should be distinctly understood that Liberian coffee is not to be looked upon as a complete substitute for *Arabica*, Mocha, or other varieties of coffee, except in low, swampy, or what is known as "heavy-bottom" land, or very rich soil in which ordinary coffee, if grown, would not be fruitful, but where this Liberian coffee would be at home.

Liberian coffee is thus especially valuable as an adjunct for either swampy land or poor, moist valley, or plain land. It is more particularly valuable for planting about cacao estates, where, the

land being moist enough and the aspect suitable for cacao, the land is stiff or poor.

The Dutch, who have always been most zealous and energetic in introducing and promoting the culture of new products, have sent out plants of the Liberian tree to their plantations in Java, and other parts of the Eastern Archipelago.

Coffee is found growing in a wild state in the province of Bambaye, the most eastern part of Fouta Djallon, between the Rio Nunez and the Rio Pongo. The island of Goree is the *entrepôt* for this coffee.

When British settlements and colonies are formed in Eastern Africa, the best coffee harvests there will be in what may be called the coffee belts from 5° to 15° north and south latitude. This would be in the south, that country which was so graphically described in Dr. Livingstone's letters, the base ports being Zanzibar and Mozambique; and in the north the old coffee-growing country of Abyssinia, and the equatorial Nile basin out of Egyptian territory. Both Dr. Livingstone and Sir Samuel Baker describe these countries as those of a terrestrial paradise, the latter speaking of boundless tracts, situated at a mean altitude of 3000 to 4000 feet above the sea-level, with a fertile soil, healthy climate, regular rainy season, and a docile population, eminently adapted for coffee cultivation.

Natal.—Looking at the number of localities on the African continent where coffee is indigenous, there is no reason why, under proper cultivation and judicious management, coffee should not succeed well in Natal. It has been grown there on a small scale, but from want of proper attention and management and neglect of weeding, or from exhaustion of the soil, the trees have been attacked with fungi, and the crop has latterly failed. In 1870 the total crop amounted to nearly 1000 tons, and 2700 cwts. were shipped; in 1874, 680 cwts., but in 1883 only 2 cwts.

The samples of Natal coffee, however, shown at the various International Exhibitions at London, Dublin, and Paris, were of good quality. In 1868 the shipments were valued at £2500, and in 1872 at £8506; in 1879 the exports were only 10 cwts., the produce being principally consumed locally.

The cultivation is now being revived with some success near the Umzimkula river and in other districts.

Production in the West India Islands.—The rapid decline in coffee production—I may almost say its abandonment—in the British West Indies, since negro emancipation, is remarkable. In 1828 we received from our West India colonies and Demerara 30,000,000 lbs. of coffee; in 1831, 20,000,000 lbs.; in 1841, less than 10,000,000 lbs.; and now but 3,000,000 lbs. reach us.

Coffee was first cultivated by the Dutch, in Surinam, early in the eighteenth century. It was next grown by the French in Martinique, and thence spread to the neighbouring islands, and to Jamaica. The Dutch jealously guarded their early efforts in this direction, and were not anxious to aid other nations in competing with them. There is a little fragrance of romance connected with

the first French effort of this kind which was made in Martinique. Louis XIV. who, in spite of all his foibles and vices, was fully able to appreciate the importance of such apparently small matters as a potato tuber or a coffee bean, had in his private gardens a coffee shrub five feet high, which, before his death (1715), bore ripe fruit. Having heard of Dutch coffee plantations in Berbice and Surinam, his ambition was aroused, and he desired to have similar ones in his French West Indian colonies. He entrusted, therefore, a slip from his pet tree to a naval officer, Declieux, with orders to carry it safely to Martinique. Unfortunately the ship in which he served had an unusually long voyage—fierce storms alternating with provoking calms, and at last the water casks were empty. The captain, however, sacrificed his own wants for the sake of the young plant, and shared with it his scanty ration of water. But his troubles were not at an end when he at last reached the island; storms and tempests, men and beasts, seemed to have united to threaten the tender shoot, and Declieux had to place a guard over the plant, who, under his supervision, watched it day and night. Fortunately it grew and thrived till it became a fine large tree, the ancestor of most of the coffee plantations in the West India Islands. It may be safely said that never was tree more carefully tended or more usefully employed.

Guadaloupe.—Coffee was formerly among the first of the staples of this colony. In 1790 it exported about 7,500,000 lbs. In 1816, when the French retook possession of the island, the coffee crop produced no more than 284,135 kilos., but starting from the succeeding year and on to 1830, it assumed considerable proportions. Guadaloupe during this period of fifteen years exported 15,260,050 kilos., being a mean annual export of over 1000 tons. From 1831 to 1845 sugar largely took its place, and the annual export decreased by one-half. From 1846 to 1860 the decrease in the coffee production was even more appreciable, the export again diminishing by one-half to less than 250 tons. From 1861 to 1878 coffee production rallied again, the exports recovering to about 450 tons. In 1885 about 7,000,000 lbs. were exported.

The three principal kinds of coffee grown in Guadaloupe are the ordinary, the Mocha, and the Liberian. The two former are held in high estimation, but the Liberian, as yet, is not much in favour, yielding more in quantity than quality.

There were, in 1873, 3588 hectares (of $2\frac{1}{2}$ acres) under cultivation with coffee; the average produce being about 1000 lbs. per hectare; in 1885, 3678 hectares produced 2,722,322 kilos. of coffee.

Martinique.—Coffee culture has almost entirely disappeared from Martinique, although the coffee grown in Guadaloupe passes in commerce under that name. The annual produce of an hectare of land under coffee here is from 500 to 1000 lbs. Owing to the attacks of the coffee insect (*Elachysta coffeola*), impoverishment of the soil, hurricanes, atmospheric influences, and other causes, the production of coffee is declining here. In 1873 there were about 1270 acres under coffee, and in 1885 only 500. There is a large local consumption, and hence the quantity shipped is but trifling.

The following shows the crops of late years in kilogrammes of a little over 2 lbs. :

		Kilos.			Kilos.
1868	..	254,553	1873	..	210,000
1869	..	145,575	1885	..	31,581
1870	..	169,480			

The shipments to France direct from Martinique vary considerably, and are but small in any year.

Jamaica is admirably suited for coffee culture from its elevated mountain ranges, and the island used to produce large crops of a very fine quality. The culture was introduced in 1728; in 1752, 60,000 lbs. were exported, and the average annual shipment in the three years ending 1807 was 28,500,000 lbs. In 1844 there were 671 coffee plantations in the island. But the culture was almost entirely abandoned, the coffee planters of the East having quite outstripped those of the West Indies by the advantages of capital, labour, and suitable land, with facilities for shipment. *Jamaica*, among the British islands, is now paying increased attention to the growth of coffee, though the distance from ports of shipment is often greater than it is in the smaller islands.

There are 22,000 acres under coffee cultivation in *Jamaica*. The principal parishes in which it is grown are St. Andrew's, St. Catherine's, Manchester, Clarendon, and St. Ann's.

TEA.

Extensive as the production and consumption of the preceding articles of commerce described—Cacao and Coffee—are, they cannot be compared in importance with Tea, the consumption of which over the world is enormous, and continually increasing.

The progress of the production of tea in other countries than *China* is necessarily interesting, as calculated to make the world more independent for its supplies.

Besides *India*, *Ceylon*, *Java*, and *Japan*, in the East, where it has made good progress, efforts are making to introduce it in parts of *Australia*, such as *Queensland* and *Victoria*, in *Jamaica*, *Natal*, and *Mauritius*. It is said to be also cultivated in the *Corea*, *Tonkin*, and *Cochin China*.

Parts of North and South America afford a vast field for tea culture, and it has long been attempted, with some degree of success, in *Brazil* and parts of the United States.

Madeira, *Teneriffe*, *Portugal*, *Spain*, *France*, *Algeria*, *Italy*, *Austria*, *Turkey*, and the *Crimea* might all grow tea, for their climates are quite suitable; *Australia*, *Tasmania*, and *New Zealand* are admirably adapted likewise, but they have little or no labour to bestow on such a cultivation. *Java* has long taken up tea culture, and produces about eight million pounds.

Tea is a very accommodating plant, both as respects climatic range and the nature of the soil in which it is planted. We find it growing from *Pekin*—which frequently has winters of Russian

The average price of tea in England, always on the decline, may be stated as follows, per pound :—

			<i>d.</i>				<i>d.</i>
1869	..	..	17·78	|	1883	..	12·46
1873	..	..	16·67	|	1884	..	11·78
1878	..	..	15·29	|	1887	..	10·58

We have no very certain means of estimating the quantity of tea consumed in China, but we may nevertheless draw conclusions from such data as we possess. Taking the population of the country, then, at 350 millions, and considering that the use of tea is universal amongst them, that they drink it from early morning until they retire for the night; that in sickness or health, working or resting, travelling or at home, it is the one great national beverage, without which no Chinese family could live and thrive; considering all this, I think I am not overrating it when I set it down at an average of $2\frac{1}{2}$ lbs. a head per annum, or say a total of 900 millions of pounds! Surely it would be equal to that of Great Britain. Others estimate it much lower—Scherzer at 400 millions; Andrie at 500 millions. Now, if we allow only 100 lbs. of cured tea as the average produce per acre in China, this will show a cultivation of 10 million acres in tea alone.

If we allow that the internal consumption of tea in China amounts to 1000 millions of pounds, we cannot but be struck with the comparatively small quantity she exports; for, according to the latest statistics, we find that her total export of tea to all countries does not reach 300 million pounds, being about one-third of her own consumption. Of this quantity the United Kingdom took about 145 million pounds in 1886.

The following figures will give a rough estimate of the production and consumption of tea :—

PRODUCTION.

	Lbs.
China, exports, 1886	295,626,000
„ assumed home consumption	1,000,000,000
British India, exports, 1887	87,514,000
„ assumed local consumption and exports to Asia	2,000,000
Java, exports	7,167,000
Japan, exports	35,759,000
„ home consumption	15,000,000
Ceylon, exports, 1886	7,860,000
Brazil, home consumption	500,000
Other small producing countries	250,000
Total	1,451,676,000

CONSUMPTION.

Of the statistics of consumption I am not able to furnish any complete details, as only for a few countries are the quantities of tea imported and sold given in their official returns.

The following figures, however, are taken from the Statistical Abstract for the principal Foreign countries, and from other

reliable documents, for the years 1873 and 1886, and dispose of a certain quantity of the tea produced and shipped from the East:—

	1873. Lbs.	1886. Lbs.
Russia	26,379,928	33,284,000
Denmark	849,635	729,000
Holland	9,625,200	5,095,200
Belgium	..	200,000
North Germany	2,000,000	3,000,000
United Kingdom	132,022,159	178,800,197
Spain, Gibraltar, and Malta	361,000	300,000
Turkey	400,000	400,000
France	6,500,000	7,859,000
United States	51,028,904	81,888,000
Dominion of Canada	8,776,781	22,582,155
Newfoundland	599,104	773,030
British West India Islands, Guiana, and Honduras	100,000	150,000
South American States	1,000,000	1,000,000
South African States	1,000,000	1,500,000
Sierra Leone, St. Helena, Falklands, and Mauritius	30,000	20,000
Victoria	10,585,795	11,968,252
New South Wales	5,021,219	7,107,038
Queensland	1,355,575	2,475,172
South Australia	1,678,325	1,991,786
Tasmania	530,500	779,904
New Zealand	2,301,308	4,442,867
Totals	262,645,433	366,345,601

IMPORTS of TEA into the UNITED KINGDOM, SHOWING the PRODUCING COUNTRIES.

Year.	British India and Ceylon.	China.	Japan.	Total Imports.
	lbs.	lbs.	lbs.	lbs.
1855	470,559	81,560,207	..	83,259,657
1865	2,037,586	112,782,845	4,021,901	121,271,220
1875	25,387,359	170,462,921	54,806	197,505,316
1885	68,624,259	139,673,354	10,286	212,143,820
1888	113,004,692	105,424,271	..	223,618,478

ESTIMATED CONSUMPTION of TEA for 1886.

	<i>Europe.</i>	Lbs.
*United Kingdom		178,800,197
*Russia in Europe		33,284,000
*Holland		5,095,200
Germany		3,000,000
*France		7,859,000
*Denmark		729,000
Belgium		200,000
Spain, Gibraltar, and Malta		300,000
Austro-Hungary		740,000
Portugal		561,000
Switzerland		300,000
Norway and Sweden		310,000
Turkey.. .. .		400,000
		231,578,397

Asia.

	Lbs.
Persia	1,000,000
India and Ceylon	2,000,000
China	1,000,000,000
Japan	15,000,000
	1,018,000,000

Africa.

Morocco	350,000
*South African States	1,500,000
	1,850,000

America.

River Plate States	1,000,000
*United States	81,888,000
*Dominion of Canada	22,582,155
*Newfoundland	773,030
	106,243,185

Australasia.

*New South Wales	7,107,038
*Victoria	11,968,252
*South Australia	1,991,786
*Tasmania	779,904
*New Zealand	4,442,867
*Queensland	2,475,172
Other small British Colonies	35,000
	28,800,019

The countries marked with an asterisk are official figures.

Summarising these returns, we arrive at the following figures :

	Lbs.
Europe	231,578,397
Asia	1,018,000,000
Africa	1,850,000
America	106,243,185
Australasia	28,800,019
	1,386,471,601

In France, although tea is not included in the official imports, the figures given are those stated for the whole of the tea imported at the French ports in 1881. Belgium and Holland are large consumers of coffee; Spain and Portugal consume chiefly chocolate. For the Austrian Empire, Italy, Greece, and some of the smaller States, there are no reliable details.

The consumption in Asia is chiefly estimated. Asiatic Russia takes a large quantity of tea overland from China, at least 60,000,000 lbs.; 560,000 lbs. of Indian tea is sent annually by land to Kabul, Kashmir, and Ladakh, and an equal quantity of Chinese teas.

From India about 20,000 lbs. of tea are sent to Arabia, and

5,000 lbs. to Aden; 20,000 to 30,000 lbs. to Turkey in Asia, and 12,000 lbs. to Turkey in Europe, and 200,000 lbs. to the United States.

For Japan I have estimated the consumption at only half a pound per head, but it must be much larger. In Northern Africa, Egypt, Tunis, &c., some quantity of tea is drunk. For South America coffee and maté are no doubt the chief articles of consumption.

There is a growing demand for tea in Morocco, nearly all bought from England. In 1887 the four principal ports imported together £33,553 worth of tea, against £31,519 in 1886.

The imports of tea into Denmark have ranged from 1,000,000 lbs. to 750,000 lbs., but the latter amount may be taken as the annual average. Holland imports about 11,000,000 lbs. annually.

IMPORTS, CONSUMPTION, ETC., of TEA in the NETHERLANDS, in CHESTS of
40 KILOGRAMMES (about 88 lbs.).

Year.	General Imports.				Consumption.		Exports in Transit.	Stock, December 31.	
	China (via England)	Java.	Other Countries.	Total.	China.	Java.	Java and China.	China.	Java.
1878	32,975	51,950	900	85,825	30,450	17,750	90,425	11,316	9,297
1879	35,450	42,875	2,025	80,350	35,300	12,825	68,525	4,985	10
1880	39,750	53,075	1,100	93,950	40,075	13,000	47,675	7,600	7,800
1881	54,675	26,675	3,100	84,450	43,625	10,900	25,150	7,000	4,900
1882	47,050	32,250	450	79,750	47,125	9,475	27,975	4,400	8,200
1883	60,100	41,200	300	101,600	52,825	16,725	46,300	2,400	300
1884	42,900	31,200	3,600	77,700	33,900	10,500	55,000	6,800	1,400
1885	47,400	36,700	7,200	91,300	44,400	9,800	68,300	5,800	1,600
1886	54,200	42,600	4,700	96,500	46,200	11,700	67,200	3,100	1,800
1887	55,300	51,600	27,700	134,600	47,200	14,100	101,800	4,000	4,505

Within the last few years there has been a singular development of the tea trade at the port of Marseilles. In 1850 the arrivals did not exceed 12,000 kilogrammes, most of which came from the warehouses of the Hanseatic towns and from London. Ten years later the direct relations with the East caused a great movement of tea to Marseilles, the annual imports being 229,114 kilogrammes, of which 223,813 came directly from China. Since then the trade has been very greatly on the increase, the quantity for 1881 being 3,198,430 kilogrammes, of which 2,878,675 were from China.

TEA IMPORTS into UNITED STATES, YEARS ENDING JUNE 30.

Lbs.					Lbs.				
1874	..	..	..	58,811,625	1881	..	..	..	81,844,000
1875	..	..	..	64,956,879	1882	..	..	..	78,769,000
1876	..	..	..	62,887,153	1883	..	..	..	73,479,000
1877	..	..	..	58,347,000	1884	..	..	..	67,666,000
1878	..	..	..	65,366,000	1885	..	..	..	72,105,000
1879	..	..	..	60,195,000	1886	..	..	..	81,888,000
1880	..	..	..	72,163,000					

The following may be given as the approximate annual tea bill of the United Kingdom :—

Annual consumption	180,000,000 lbs.
Retailed at 1s. 11d. per lb.	£17,250,000

Average wholesale price, including freight and London charges :—

90,000,000 lbs. China and Java at 9d.	£ 3,375,000
90,000,000 lbs. India and Ceylon at 1s. 0½d.	4,593,750
Duty on 180,000,000 lbs. at 6d.	4,500,000
Cost of distribution and gross profit to dealers	4,781,250
	<u>£17,250,000</u>

IMPORTS of TEA into EUROPE, in CHESTS of 40 KILOGRAMMES.

(From the Rotterdam Trade Circulars.)

Year.	Imports.	Deliveries.	Stock, December 31.
1878	2,645,900	2,646,500	1,462,300
1879	2,415,100	2,640,100	1,270,500
1880	2,672,000	2,684,900	1,318,600
1881	2,726,700	2,655,400	1,345,500
1882	2,764,500	2,712,900	1,449,900
1883	2,910,800	2,839,300	1,538,300
1884	2,747,300	2,876,200	1,433,600
1885	2,719,200	2,921,000	1,264,300
1886	2,966,500	2,919,100	1,337,800
1887	2,874,800	2,896,800	1,347,800

Culture in China.—The tea plant (*Thea Chinensis*, Linné; *Camellia Thea*, Link) has a bushy stem, with numerous branches, and very leafy. It flowers with a white blossom, and ranges in height, when fully grown, from three to six feet. It is hardy, and readily grows in Asia from the equator to the 45th degree of latitude; but in China, although grown in most of the provinces, its cultivation is chiefly restricted to the five maritime provinces, viz., Kuang-tung, Fukian, Kiangse, Kianguan, and Chekiang, lying in the south-east part of the empire, between the 21st and 33rd degrees north latitude. It is only from these that tea is brought for the great export demand, though it is grown in every other province, as far north as 42 degrees for mere local consumption. It is also produced in the Japanese Islands which are north of 35 degrees; in Cochin China, and, to some extent, by runaway Chinamen in Luzon and Java. The climate that seems to suit the plant best in China is that of the country included between the 25th and 35th degrees of north latitude. The plant does not yield a crop under two or three years. A low alluvial soil is not favourable to its growth, a hilly country being decidedly the best adapted to its full development. There is little or none near Canton, for this reason, and also because the climate is too warm. All accounts agree that it thrives best in a temperate climate and upon the sides of hills. The crops are gathered in the spring.

Baron Mueller remarks that it seems very doubtful whether the tea plant is really indigenous in the Chinese Empire, unless in the, to us, largely unknown western districts; for, as far as we are aware, it has been carried from Assam and Cachar, and possibly also from Siam and Cochin, just like the coffee plant, which is not really a native of Arabia, as was so long supposed, but came originally from Abyssinia. The culture commenced, so far as can be historically ascertained, in China, during the fourth, and in Japan during the ninth century, from whence tea was obtained exclusively for every other part of the globe till the time of the present generation.

Tea grows in every province in China except three or four upon the northernmost Siberian border, but the quality and quantity depend largely upon the locality. The leaves resemble those of the willow, and are gathered during the spring and early summer. The annual average yield of a tea plant is about twenty ounces, and too much rain affects the quality as well as the amount. The plants live from twenty to thirty years, and, when old, are frequently cut down, and a young shrub grafted into the old stock. Quicker returns are thus obtained, but the plant does not last so long. The leaves are first exposed in a cool, dry place for a day or two, then rolled into a ball on a table of bamboo slats, and dried in the sun. The rolling is to extract a portion of the juice of the leaves. After they have been dried in the sun, they are put into an egg-shaped iron pan over a charcoal fire, and incessantly stirred until a certain point of dryness is reached. The operator stirs with his hands, thrusting them in all portions of the pan, and practice enables him to dry the leaves almost exactly alike. The raiser superintends this process, and then brings his tea in bamboo baskets to the tea merchant, who adjudges its quality, and buys it at prices ranging from 15 dollars to 20 dollars per picul of 133½ lbs. The merchant mixes his purchases together in a large reservoir, and at his convenience weighs out a number of pounds of tea leaves; women and children spread them upon a large stage, and separate the leaves into grades according to quality. The tea stalks are the lowest grade, and the sorters are paid by the number of ounces of stalks they bring in. Children earn from 2*d.* to 6*d.* a day; the very best workers rarely earn as much as 6*d.* a day.

After the sorting each grade is packed by itself in chests or bamboo baskets, the first for exportation, and the latter for home consumption. It is ordered by importers abroad through a tea-taster, who receives a high salary.

The green and black teas of commerce are made from the same plant, the difference arising solely from the difference in the manufacture, the green tea being made direct from the green leaf, while the black is allowed to wither by exposure to the sun, or hot air, before manufacture.

For Green Tea.—When the leaves are brought in from the plantations they are spread out thinly on flat bamboo trays, in order to dry off any superfluous moisture. They remain for a very short time exposed in this manner, generally from one to two hours; this, however, depends much upon the state of the weather.

In the meantime the roasting pans have been heated with a brisk wood fire. A portion of leaves is now thrown into each pan, and rapidly moved about and shaken up with both hands. They are immediately affected by the heat, begin to make a crackling noise, and become quite moist and flaccid, while at the same time they give out a considerable portion of vapour. They remain in this state for four or five minutes, and are then drawn quickly out and placed upon the rolling table.

Having been thrown again into the pan, a slow and steady charcoal fire is kept up, and the leaves are kept in rapid motion by the hands of workmen. Sometimes they are thrown upon the rattan table and rolled a second time. In about an hour, or an hour and a half, the leaves are well dried and their colour has become fixed—that is, there is no longer any danger of their becoming black. They are of a dullish green colour, but become brighter afterwards.

The most particular part of the operation has now been finished, and the tea may be put aside until a larger quantity has been made. The second part of the process consists in winnowing and passing the tea through sieves of different sizes, in order to get rid of the dust and other impurities, and to divide the tea into the different kinds known as twankay, hyson skin, hyson, young hyson, gunpowder, &c. During this process it is refired, the coarse kinds once, and the finer sorts three or four times. By this time the colour has come out more fully, and the leaves of the finer kinds are of a dull bluish green.

It will be observed, then, with reference to green tea—1st, that the leaves are roasted almost immediately after they are gathered; and 2nd, that they are dried off quickly after the rolling process.

For Black Tea.—When the leaves are brought in from the plantations they are spread out upon large bamboo mats or trays, and are allowed to lie in this state for a considerable time. If they are brought in at night they lie until next morning.

The leaves are next gathered up by the workmen with both hands, thrown into the air and allowed to separate and fall down again. They are tossed about in this manner, and slightly beat or patted with the hands, for a considerable space of time. At length, when they become soft and flaccid, they are thrown in heaps and allowed to lie in this state for about an hour, or perhaps a little longer. When examined at the end of this time, they appear to have undergone a slight change in colour, are soft and moist, and emit a fragrant smell.

The rolling process now commences. Several men take their stations at the rolling table and divide the leaves amongst them. Each takes as many as he can press with his hands, and makes them up in the form of a ball. This is rolled upon the rattan table, worked and greatly compressed, the object being to get rid of a portion of the sap and moisture, and at the same time to twist the leaves. These balls of leaves are frequently shaken out and passed from hand to hand until they reach the head workman, who examines them carefully to see if they have taken the

requisite twist. When he is satisfied of this, the leaves are removed from the rolling table and shaken out upon flat trays, until the remaining portions have undergone the same process. In no case are they allowed to lie long in this state, and sometimes they are taken at once to the roasting pan.

The next part of the process is exactly the same as in the manipulation of green tea. The leaves are thrown into an iron pan, where they are roasted for about five minutes, and then rolled upon the rattan table.

After being rolled, the leaves are shaken out, thinly, on sieves, and exposed to the air out of doors. A framework for this purpose, made of bamboo, is generally seen in front of all the cottages amongst the tea hills. The leaves are allowed to remain in this condition for about three hours: during this time the workmen are employed in going over the sieves in rotation, turning the leaves and separating them from each other. A fine dry day, when the sun is not too bright, seems to be preferred for this part of the operation.

The leaves, having now lost a large portion of their moisture, and having become reduced considerably in size, are removed into the factory. They are put a second time into the roasting pan for three or four minutes, and taken out and rolled as before.

The charcoal fires are now got ready. A tubular basket, narrow at the middle and wide at both ends, is placed over the fire. A sieve is dropped into this tube and covered with leaves, which are shaken on it to about an inch in thickness. After five or six minutes, during which time they are carefully watched, they are removed from the fire and rolled a third time. As the balls of leaves come from the hands of the roller they are placed in a heap until the whole have been rolled. They are again shaken on the sieves as before, and set over the fire for a little while longer. Sometimes the last operation—namely, heating and rolling—is repeated a fourth time; the leaves have now assumed a dark colour.

When the whole has been gone over in this manner it is then placed thickly in the baskets, which are again set over the charcoal fire. The workman now makes a hole with his hand through the centre of the leaves, in order to allow vent to any smoke or vapour which may rise from the charcoal, as well as to let the heat up, and then covers the whole over with a flat basket; previous to this the heat has been greatly reduced by the fires being covered up. The tea now remains over the slow charcoal fire until it is perfectly dry; it is, however, carefully watched by the manufacturer, who every now and then stirs it up with his hands, so that the whole may be equally heated. The black colour is now fairly brought out, but afterwards improves in appearance; the after processes, such as sifting, picking, and refining, are carried on at the convenience of the workmen.

It is evident therefore that the main part of the preparation of tea is carried on upon the spot where it is grown, and that an increased quantity could easily be prepared without any increase either of machinery or hands for the purpose.

Formerly this delicate herb required to be so well fired and packed by the Chinese as to stand the long overland journey from the tea districts to Canton, where it often came into the hands of the foreign shipper a whole year after it had been picked. Now, within three months of the time that the leaf was growing, we find the prepared article actually in the hands of the home consumer. A careless manipulation and an insecure kind of packing have thus been gradually adopted by the Chinese, who find all that is wanted is, that the tea should arrive unimpaired into the godown of the foreign merchant, often not three days' journey from the up-country packing house. The fragrant smell of the newly-dried herb deceives the buyer, whose home correspondent comes into possession of a totally flavourless preparation. The subordinate part allotted to the cultivation of the tea plant in China is one of the most striking facts observed by the traveller in the country. When he first arrives in the tea districts he is led to imagine himself still only on their confines; isolated patches here and there meet his eye, in place of the wholesale plantations he had looked forward to, and on enquiry he finds that among the enumeration of taxable lands sent in to the Emperor, tea land is entirely ignored. In fact, until recently, the up-country farmer, who persists in growing an inferior paddy almost on the highest mountain tops, on the theory that each district should, as nearly as possible, be self-supporting, grew a few shrubs in the corner of his garden, or gathered for his own requirements from the wild hill plant. Although of late years the country people have begun to see the value placed on a hitherto almost worthless herb, the cultivation of the tea plant is still far from being carried on in a really systematic manner, and five or six piculs is a large average yield for an individual farm.

In China tea nurseries are seldom extensive, but every village has its one or two acres devoted to the national product.

Shanghai is the leading tea port in China, not only for shipments to Great Britain, but also to America.

TEA EXPORTS from CHINA, in PICULS.

Year.	Black.	Green.	Brick.	Dust.
1874	1,444,249	212,833	74,791	3,504
1875	1,438,611	210,281	166,900	2,594
1876	1,415,348	189,714	153,950	3,798
1877	1,552,173	197,521	147,809	12,157
1878	1,517,617	172,826	194,277	14,236
1879	1,523,418	183,233	275,540	5,269
1880	1,661,325	188,623	232,969	14,200
1881	1,636,724	238,064	247,498	15,186
1882	1,611,916	178,839	219,026	7,367
1883	1,571,092	191,115	218,741	6,125
1884	1,564,452	202,557	244,996	4,212
1885	1,618,404	214,693	280,112	15,505
1886	1,654,058	192,930	361,492	8,719

These figures show an export by sea of about 295,000,000 lbs. In 1873 the shipments were 236,000,000 lbs., so that not much progress has been made in thirteen years.

EXPORTS of TEA from other PRINCIPAL PORTS, in PICULS.

Ports.	1883.	1884.
Canton	132,406	124,870
Foochow	606,891	677,606
Ningpo	127,059	156,742
Hankow	771,344	794,630
Tientsin	290,204	314,605

The exports from Canton fell from 16,456,446 lbs. in 1882 to 13,988,827 in 1884. The tea sent from Tientsin goes principally to Russia and Siberia *viâ* Kiachta.

EXPORTS of TEA from CHINA, in PICULS of 133 lbs.

Kinds.	1874.	1884.	1885.	1886.
Black	1,444,249	1,564,452	1,618,404	1,654,058
Green	212,883	202,557	214,693	192,930
Brick	74,791	244,996	280,112	361,492
Dust	3,504	4,212	15,505	8,719
	1,735,427	2,016,217	2,128,714	2,217,199

Sealed Tea, is a kind of coarse tea, imported into Kiachta from China, thus named from being pressed into solid sealed packages, weighing about 3 lbs. each, so firmly compacted together that nothing less than hammer and chisel will break it. The leaves of this tea are old and tough as leather; the twigs and stalks are intermingled, and some fatty substance is mixed with it to make it cohere.

The Burmese consume an immense quantity of tea leaves pickled with oil and garlic. It is a compound which is eaten, not drunk. There was imported into India of this *Litpet*, or pickled tea, from Upper Burma the following quantities:—

Maunds.	Value. £	Maunds.	Value. £
In 1878-79 it was 29,090	54,142	In 1880-81 it was 15,036	43,975
„ 1879-80 „ 11,896	24,884	„ 1881-82 „ 5,934	16,573

A kind of tea is exported from India to Ladakh, known as *gola*, or ball tea, which is said to be a mixture of green and black tea with rice water.

Brick-Tea.—Mr. James McPherson in a communication made to the “Journal of the Society of Arts,” some years ago, states that the commerce in brick-tea is so extensive among the people of

Central Asia, that it seems wonderful so little should be known on the subject.

Kiachta, a frontier town in Eastern Siberia, was, up to the year 1861, the principal mart for brick-tea; the monopoly, held by a first-class guild of Russian merchants, was abolished in that year, however, and in 1862, the frontier custom-house was removed to Irkutsk, since which time tea has entered the portion of Siberia eastward of Lake Baikal, free of duty. Moreover, the importation of sea-borne tea was legalized in April, 1862, in spite of strong protests from Kiachta; this was intended to put a stop to the contraband trade, and the high prices charged to consumers by the Kiachta monopolists.

Some attempts have been made, on the part of the Indian tea planters, to invite the Tibetans and others to deal with them, but (so far as brick-teas are concerned) without much success. This may be due to the general ignorance prevailing as to the proper method of manufacture.

Mr. C. M. Grant, of Kiachta, says the coarser leaves are moistened by steam, and then compressed in moulds in the shape of bricks, which are stacked so that the air may freely circulate and dry them; this is for green brick-tea; black brick-tea is fabricated from the refuse black teas, or the siftings of the teas prepared for the European markets.

In England the steaming process seems to strike the mind as a fallacy at first, but this arises rather from its being so very different from the ordinary descriptions of the method of preparation, than from any real defect or difficulty in the process itself.

The allusions to the manufacture of brick-tea in the English language are exceedingly rare. It is mentioned in the *Asiatic Journal* (I think) that in the reign of Jin-Tsung (A.D. 1023-63) teas were of two kinds: the first kind, called *Peen-tcha*, was the leaves combined together in a mass in the form of a board, and then dried by the action of fire. The second kind was called *San-tcha*, being the leaves reduced to powder.

Steaming seems to have been known long before this time, however, and some Chinese authors consider it to have been the earliest known method of manufacture. Von Siebold mentions a method of steaming used in Japan for the preparation of green teas; he says the leaves are laid on mats, in a square box or chest, into which the steam is introduced from a kettle. There are undoubtedly a very great many methods, just as there are in the preparation of ordinary teas, and further information is very desirable, as to the means employed by the Russian agents in the interior of Hupeh (Hu-kuang), for steaming the leaf, the ordinary time employed in drying the bricks, and the temperature of the air and general state of the weather, &c.

The utilization of the refuse of the tea manufacture is a feature in Chinese economy which well deserves the attention of Indian planters; and the admirable product resulting from it claims the attention of philanthropists both there and at home. It is well

known that, from the prolonged manipulation which tea leaves undergo, a large percentage becomes much broken, or is reduced to powder, and thereby deteriorated in value. It may seem strange to many why tea dust and siftings should be considered as refuse at all, seeing they are still tea; more especially when, as a rule, they yield a stronger infusion than the finest and most perfectly-curved leaves. This apparent incongruity disappears, however, on closer investigation. When in the form of dust its liability to adulteration with sand or other heavy foreign substances is vastly increased; and in siftings, fannings, or broken leaf, an irresistible temptation is offered to the introduction of the broken leaves of other less valuable plants. Then again the darker infusion is usually obtained only at the first maceration, the boiling water so acting on the pulverized leaves that nearly their whole strength is extracted at once; whereas, with closely-twisted leaves, a second, third, or sometimes even a fourth infusion fails to deprive them of all soluble material. Under such circumstances the Chinese merchant, in order to encourage business in good leaf, frequently sells his dust and siftings at a low figure, if not at a price under cost. But it happens that a vast quantity of refuse is produced in a district of the Empire so remote from the "Treaty ports," where alone business can be profitably transacted with foreigners, that some other opening had to be discovered. Such an outlet the Chinese speedily found in the manufacture of brick-tea for the Russian market.

This strange phase of the fragrant herb takes three forms: Large Green, Small Green, and Black Bricks.

The large green variety is manufactured in the hilly regions in the province of Hupeh, about two hundred miles west of Hankow. It is fabricated out of the coarser leaves and upper twigs of the tea shrub, to which are added much of the broken leaf and dust resulting from green tea manipulation. The mass is simply moistened by the application of steam, then compressed in wooden moulds, having the chop of the manufacturer cut in relief on one of the inner surfaces. The bricks are then piled up in stacks protected from the sun and rain, but having a free current of air circulating through and around them. When quite dry, each brick is enveloped in paper; thirty-six bricks, built into an oblong figure, are covered with dry fragrant leaves, and the whole matted over. Such packages are known as "baskets."

In colour this form of tea exhibits a dusky green, and is made to a large extent by the Russian agents of the Kiachta merchants. It sells at Kiachta at about three roubles (1 rouble = 3s. 2d. sterling) more per basket than that made by the Chinese; but then it should be remembered it costs the Russian agents from 50 to 75 tael cents (1 tael = 6s. 8d. sterling there) more at Hankow. Large green bricks measure $13 \times 6\frac{1}{2} \times 1\frac{1}{4}$ inches, the weight of the basket being about 83 catties, or nearly 111 lbs. avoirdupois.

Unlike the method employed in Mincing Lane for testing the quality of tea, the Mongol buyer proves the soundness of his

purchase by placing a brick upon his head and pulling the extremities downwards with both hands; should it neither yield nor break, it is considered sound; if it bends or fractures, it is unhesitatingly tossed aside as worthless. Occasionally a similar test is practised over the bended knee.

Among all the native inhabitants of Mongolia, and a large number of the Bouriaks who live in the neighbourhood of the Russo-Mongolian frontier, this description of tea is in favour. The chief markets are Chang-kia-kow, Ourga, and Kiachta.

Small green brick-tea is always superior to large, from the simple circumstance that much greater care is bestowed on the selection of the materials, and during the manufacture; consequently it commands a higher price, although its fabrication is similarly conducted. It is consumed by the Siberian peasantry and the better class of Bouriaks and Toungous resident near the Mongolian frontier. Even the Mongol mandarins, both in their native country and when attached to the court at Pekin, prefer this tea. The usual size of the brick is $8\frac{1}{2} \times 5\frac{1}{4} \times \frac{7}{8}$ inches, and the principal emporiums for their distribution are Kiachta, Chita, and Nerchinsk.

Neither of these two forms of brick-tea undergoes fermentation. Black brick-tea, named in Mongolia "Dirintirroo," is made into cubes of the same size as small green. It consists of siftings, fannings, and the dust resulting from the preparation of Moning and Kaisow teas for the London market, with an admixture of Bohea and small twigs. Like small green, it is usually packed with 64 or 72 bricks in a basket, and is in request among the Tartars or Khirgis of Western Siberia. Large quantities are also sold to the peasantry residing on the western shores of Lake Baikal. The native markets are Kiachta, Irkoutsk, Omsk, Tomsk, Kazaw; and Nijni Novgorod and Irbit, during the fairs.

The average prices obtained by the Russians at the markets stated are as follows:—

Sort.	Basket of	Per Basket.	Weight.
Large green bricks	36 bricks	4 taels	111 lbs. avoird.
Small green "	64 "	4 "	93 $\frac{1}{2}$ "
Small black "	64 "	4 $\frac{1}{2}$ to 5 taels	93 $\frac{1}{2}$ "

As already mentioned, the brick-tea of Chinese manufacture fetches a rather lower price.

A few statistics may prove instructive, especially to such of our Indian tea-planters as, from the favourable positions of their gardens, may in future have opportunities of cultivating the brick-tea trade in competition with the Russian merchants.

The commerce, until within the last twenty years, was wholly in the hands of the Chinese; but, forecasting events, and depending on the superiority of European to Asiatic manipulation, the Russian merchants of Kiachta boldly sent their own agents to

Hupéh, who have not only succeeded in producing a better quality of tea, but have since then monopolized a considerable percentage of the brick-tea trade. This no doubt arose partly from the fact that foreigners possess an advantage over the Chinese, inasmuch as they are not mulcted in such heavy inland duties. The quantity of Russian manufactured brick-tea which crosses the frontier is annually increasing, whereas that made by the natives is as steadily on the wane.

The sales at Ourga, the capital of Mongolia, about 200 miles from Kiachta, are said to be upwards of 50,000 baskets per annum (over 5,000,000 lbs.), of which nine-tenths are large green brick.

The Chinese transport the greater portion of their brick-tea overland *viâ* Shansi, whilst the Russians invariably send theirs *viâ* Shanghai and Tientsin to Kiachta, whence it is transported to Siberia, Tartary and Russia on the backs of camels.

In Mongolia and Tartary the method of preparing brick-tea for drinking is unique, and is suggestive of a cheap and admirable substitute for food during times of commercial distress and famine.

It is rubbed to fine powder, boiled with alkaline steppe-water, to which salt and fat have been added, the decoction being carefully decanted. Of this liquid the nomadic races drink from twenty to forty cups per day, mixing it first with milk, butter, and a little roasted meal. But even without meal, they subsist on the beverage, and maintain perfect health and a robust physique for many weeks in succession.

Moorcroft says all classes of Tibetans take tea twice a day; for a breakfast of ten persons, this would be the preparation. About an ounce of brick-tea (*Zan-cha*) and a like quantity of soda, boiled in a quart of water for an hour, or until the leaves of the tea are sufficiently steeped. It is then strained and mixed with ten quarts of boiling water, in which an ounce and a half of fossil salt has been previously dissolved. The whole is then put into a narrow cylindrical churn along with butter, and well stirred with a churning stick until it becomes a smooth, oily, and brown liquid, of the colour and consistence of chocolate, in which form it is transferred to a teapot. Each person drinks from five to ten cups of tea.

Ya-tcheon or Ya-tzon, the last large town of Western China, is famous for its manufacture of brick-tea, which gives occupation to thousands of workmen either in its manufacture or transport to Ta-tsien-lou. This tea can only be made with a particular leaf. The tree which furnishes it grows on the banks of the river Yaho. It is not a mere shrub, like that from which the tea for Europe is made, but it attains often fifteen feet in height, and the leaves are large, and rough to the touch. The cultivation requires little care. It is planted often on the borders of fields, or round the houses. Each grower gathers his little harvest of leaves, and finds a ready sale for them in the market of the town. The manufacture of brick-tea is a monopoly secured to the dealers of this town, and for

which they pay a considerable sum to the Chinese Government. Mr. Cooper, a recent English traveller, although not allowed to enter one of these tea factories, obtained some valuable information on the subject, from which we deduce the following facts. For the first quality tea, the leaves are gathered in June and July, before the spring rains commence. The leaves at this period of the year are about an inch in length. As soon as detached, they are spread in the sun, and when slightly dried or withered, they are rolled with the hand until they become humid with the exudation of the sap. They are then made into balls, about the size of a large teacup, and left to ferment. When they are in fermentation, they are placed between wooden moulds or lever presses, secured by pegs or bolts. These moulds are then placed over a wood fire. The tea is taken out in a compact mass, and forms the brick-tea of commerce. They are delivered to the merchants of the town, by whom they are wrapped in yellow paper, on which is impressed the stamp of the government and the mark of the dealer who exports it. They are then placed in baskets of plaited bamboo, about four feet long. One of these baskets, weighing about twenty pounds, is the unit of trade. The baskets are carried on men's backs to Ta-tsien-lou, a distance of two hundred miles. There they are carefully wrapped in fresh hides, to prevent the tea from imbibing moisture. They are then fit to be sent to Lhasa, or even beyond; Thibet, in fact, consumes the brick-tea which is made in Ya-tcheon. A basket costs about twelve taels, that is, at the rate of 4s. 8d. the English pound. There are two other qualities of brick-tea. The second kind is made with older and yellow leaves. The mode of preparing is the same. It is sent chiefly to Lithang and Bathang. At the latter place it sells for about five taels the basket, or at the rate of 1s. 6d. the pound. The third quality is made with the waste and *débris* of the leaves. The bricks of this quality resemble those sometimes made with the young shoots of the tea tree cut up. The manufacture differs from the two other sorts, inasmuch as it is necessary to add rice water to combine the substance and to make it retain the form of the mould. This quality is only sold at Ta-tsien-lou and its neighbourhood, and fetches 9d. per pound. The quantity of brick-tea exported annually from Ya-tcheon to Thibet is roughly estimated at six million pounds. The high price of tea in the markets of Thibet arises from the monopoly of the Chinese, which is increased by that of the Lamas, who keep in their hands the retail sale. And as tea is an article of prime necessity in Thibet, thanks to this double monopoly, the Celestial Empire keeps in dependence the Lamas, and by them the people of Thibet. Comparing the exorbitant prices of this important commodity in the markets of Bathang and Lhasa with the present moderate value of the tea raised in British India, in the valley of Assam and the slopes of the Himalayas, a great source of profit would arise to Indian planters and merchants by opening up a means of communication between Assam and Thibet. Where coin is valueless, a few handfuls of tea will procure many necessities in Thibet.

EXPORTS of BRICK TEA from CHINA in PICULS of 133½ lbs.

1874	..	..	..	74,791	1881	..	..	..	247,498
1875	..	..	..	166,900	1882	..	..	..	219,026
1876	..	..	..	153,950	1883	..	..	..	218,744
1877	..	..	..	147,809	1884	..	..	..	244,996
1878	..	..	..	194,277	1885	..	..	..	280,112
1879	..	..	..	275,540	1886	..	..	..	*361,492
1880	..	..	..	232,969					

* This is over 48,000,000 lbs.

India.—The tea plant appears to flourish best in a subtropical climate, in British India for instance, in N. lat. 25° to 28°, and requires a most excellent soil, a very large average rainfall, and a comparative high temperature.

Planters differ in their opinions of the kinds of soil most suited for the growth of tea; but there can be no doubt that the virgin soil of the dense forests at the foot of the hills, where the climate is hot and moist, and where tea is often found indigenous, is the best. But tea will grow well in every district in Assam.

The growth of the tea industry in India has been almost unexampled in the history of its trade. The following figures represent the value of the annual exports, and there is every reasonable prospect of a continued progress, which will ultimately give Indian tea a foremost place among the productions of the country:—

EXPORTS of INDIAN TEA, YEARS ENDING MARCH 31.

				Lbs.					Lbs.
1877	..	..	..	27,925,400	1883	..	..	..	58,233,345
1878	..	..	..	33,656,715	1884	..	..	..	60,473,113
1879	..	..	..	34,800,027	1885	..	..	..	65,147,897
1880	..	..	..	38,405,632	1886	..	..	..	62,784,249
1881	..	..	..	46,918,539	1887	..	..	..	78,702,857
1882	..	..	..	49,255,342	1888	..	..	..	87,514,155

The exports in the last year were made to the following countries:—

					Lbs.
United Kingdom	..	..	..	..	84,181,925
Australia	..	..	..	..	2,471,927
United States	..	..	..	..	54,324
Other countries	..	..	..	..	805,979

The value of the tea shipped in 1888 was given at £5,174,420.

This growth is very astonishing. The economic effects of the industry have not yet, however, been as fully examined as they should be. The trade has expanded year by year without interruption, and it will no doubt continue to develop. Tea now constitutes one of the most prosperous industries of India.

This product is nearly all shipped from Calcutta.

The successful results of tea cultivation in India must be regarded under two points of view:—

1. The tea supply and tea demand in the world.
2. The tea supply in India, and the demand for Indian as op-

posed to China and other similar teas, such as those from Japan and Java.

First, then, of the tea supply and tea demand in the world. What is the present supply? China stands at the head of the list. The exports from that country (for we are not concerned here with what is consumed within the empire) may be put down roughly as considerably over 295 millions of pounds. India comes next; the internal consumption is a mere bagatelle, and the export may be stated at 87 millions. Perhaps 43 millions will cover the exports from the other two places named. Assuming, then, China, at the outside, to export 300 millions we have a grand total of produce for the tea-drinking, but non-tea-producing countries of about 430 millions of pounds.

Of the above, Great Britain alone receives, in round numbers, over 223½ millions—that is, over 105 millions from China, and 113 millions from India and Ceylon.

We have then only about 204 millions left for all the other non-producing but tea-drinking countries.

It is true that some of these cannot fairly be included as consumers of this said balance, notably Russia and a portion of many parts of Asia, to which tea is imported direct overland from China. Including the tea that goes to those countries (the China produce, by-the-bye, is probably far in excess of the 300 million pounds we have assumed, but correct figures on this head are not obtainable, nor do they here concern us), the fact remains that to supply all the world, with the exceptions above, to which Great Britain is added, only about 200 millions of pounds are available.

When we consider, as already shown, that Great Britain alone consumes nearly 185½ millions, it is evident that 200 millions is but a scant supply for all outside her—America and Australia, both large tea-drinking countries, with rapidly increasing populations. The Australasian Colonies take over 27 million pounds; California and the Atlantic States 82 million pounds.

The continent of Europe will take more and more tea yearly, for the taste is fast being acquired. The same may be said of many parts of Asia, and if tea is ever drunk by the millions in India, then—but we need not speculate so far ahead.

It is evident that, supposing the China supply to be a fixed figure which will not increase, any extension in India that now appears possible (the labour sets a limit to it) will not only not exceed the demand, but scarcely keep pace with it.

Some have started the theory that new tea-producing countries will spring up and compete with India, notably large tracts in tropical America, which have suitable climates, but I think the fear is groundless. Two conditions are necessary for a tea-producing country—a good tea climate, which is more or less rare, and good and cheap labour. These China and India have, the latter in perfection in many parts; but outside these two, to which add Java and Japan (the latter fails in cheap labour), what country possesses the said two requisites?

The indigenous tea tree was discovered growing wild in the

forests of Assam. These forests clothe the hills which form the boundary between India and China, and it is a fair assumption that the plant or its seed was thousands of years ago exported from India into China, where it has become an important industry. Tea has not been cultivated in India for half a century, the oldest company, called the Assam Company, having been founded in 1850. It is now cultivated in a dozen different parts of India, hundreds or thousands of miles apart, some being on the north-east or east, others on the north-west or south of India. The chief tea-producing countries of India are Assam, Cachar and Sylhet, Chittagong, Chota Nagpur, Darjeeling, Dehra Doon, Dooars, Kangra, Kumaon, Nilgiris, and Ceylon. Upwards of 267,000 acres of jungle have been cleared by our countrymen in India and planted with tea, employing over 300,000 people in the cultivation. Most of the 85,000,000 lbs. of tea annually sent home is manufactured by machinery.

For several years Indian tea was little known, and not much was produced. Now India supplies the bulk of the entire consumption of the United Kingdom. It is principally used by the trade to give strength and flavour to the teas of other countries, thereby covering their deficiencies.

The following table shows the growth of the trade in Indian tea, and speaks eloquently of the appreciation it has secured:—

In 1860, out-turn about 1,000,000 lbs.			
„ 1864,	„	3,000,000	„
„ 1874,	„	18,000,000	„
„ 1884,	„	70,000,000	„
„ 1887,	„	88,000,000	„

The whole consumption of the United Kingdom in 1888 was 185,500,000 lbs., of which more than half was Indian.

The discovery that the tea plant was indigenous in the Indian forests was made about seventy years ago, and attention having been drawn to its cultivation as a possibly profitable field for investment, a committee was appointed to consider as to the best methods of cultivating tea in India, Government gardens were established in several places, and the difficulties inseparable from pioneering and from establishing an enterprise about which little was understood, were increased by the accepted idea that the manipulation of the tea leaf was a mystery known only in China. Much difficulty, too, was experienced in procuring seeds and plants, and though the real indigenous tea was known to be present in the Indian forests, the supply of seeds was at first drawn from China. The formation of experimental gardens was a slow and laborious work.

The cultivation and manufacture of tea has now become one of the most important industries of India. It is almost entirely conducted with European capital, and the article manufactured is of so superior a quality that Indian tea is gradually driving out China and Japan tea from the markets of Europe, Australia, and America.

There are now upwards of 3500 plantations in India with an area of nearly 300,000 acres actually under tea cultivation. The capital embarked in this enterprise in India is £18,000,000, and the labour employed is considerable. In Assam alone there are about 280,000 labourers on the tea estates.

STATEMENT of TEA CULTIVATION in BRITISH INDIA in 1884.

Province and District.	No. of Plantations.	Acreage under Mature Plants.	Acreage under Immature Plants.	Total Area under Tea.	Acreage taken up for Planting but not yet Planted.	Approximate Lbs. of Tea.	Average Yield per Acre of Matured Plants.
<i>Assam, Brahma-pootra Valley—</i>							lbs.
Luckimpur ..	153	25,881	2,524	28,405	100,987	11,317,813	437
Seebangor ..	232	39,021	4,863	43,884	145,256	13,164,749	337
Durnung ..	126	13,269	3,410	16,679	40,831	4,384,141	330
Nowgong ..	70	9,251	1,600	10,851	60,099	3,074,115	332
Kamrup ..	87	5,546	797	6,343	18,557	960,668	173
Goalpara ..	8	267	228	495	1,017	85,621	320
<i>Assam, Surma Valley—</i>							
Kachar ..	183	46,299	6,064	52,363	171,677	12,578,499	272
Silhet ..	111	18,624	12,208	30,832	102,294	5,560,593	298
<i>Bengal—</i>							
Darjeeling ..	170	29,127	6,395	35,522	10,916	7,955,987	273
Western Doonars	106	7,648	5,615	13,263	42,432	2,673,884	350
Chittagong, &c.	26	2,706	598	3,304	18,553	763,166	182
Chota Nagpur	36	2,276	1,333	3,609	4,962	347,253	152
<i>Punjab—</i>							
Kangra Valley	1,925	6,730	1,442	8,172	1,756	1,334,002	191
<i>N. W. Provinces—</i>							
Kumaon and Gurhwal ..	51	2,765	716	3,481	2,278	473,137	171
Dehra Doon ..	34	3,729	1,217	4,946	1,635	769,213	206
<i>Madras—</i>							
Nilgiris ..	72	3,414	543	3,957	3,449	395,960	116
Travancore ..	27	818	669	1,487	1,670	105,740	142
Sundry districts	15	70	48	118	40	3,405	49
	3,432	217,441	50,270	267,711	728,409	65,947,946	303

There are 125 joint-stock tea companies in Bengal, three in the North-West Provinces, and one in the Punjab.

A table prepared of the results of the working of twenty-four leading Indian tea companies, registered in London, for the year 1885, gave the following results:—

Total paid-up capital	£2,531,470
Total acreage	48,158
Average capital per acre	£52
„ yield per mature acre	340 lbs.
Total crop of 1885	14,637,314 „
Average cost of tea per lb.	11d.
„ value „ „	1 2½d.
Dividend on crop, average	6 per cent.

The extent of tea cultivation and the out-turn in the financial year 1886 in the several provinces where it is grown in India, are shown in the following official statement issued by the Under Secretary of State for India:—

Districts.	Acres.	Yield in Lbs.
Assam and Kachar	197,510	53,617,020
Bengal	63,489	14,049,681
N. W. Provinces	8,493	1,520,109
Punjab	7,900	1,376,732
Madras	6,370½	938,963
Burma	163	18,295
Totals	283,925½	71,520,800

The tea industry goes on extending. In Assam, where by far the largest quantity of Indian tea is produced, the produce per acre varies remarkably in various districts. In Luckimpur it is put at 479 lbs., in the Nilgiris at 253 lbs., while in Kamrup it is only 172 lbs. per acre.

The culture of tea in Southern India is mainly confined to the upper slopes of the Nilgiri mountains, where the estates are located at elevations varying from 3500 to 8000 feet above sea-level. At higher elevations they are above fever range, and enjoy a pleasant climate, somewhat like that of the south of France. In the centre of the Nilgiri plateau the average maximum temperature is about 69°, and the average minimum about 49° Fahrenheit, and the rainfall about 40 inches. Further west, the minimum and maximum are 54° and 66° respectively, and the rainfall is about 105 inches. On the eastern slopes the temperature is higher and the air less moist. The first attempt to introduce the tea-plant into Southern India was made in 1837 by the Agri-Horticultural Society of Madras, but it is only of late years that much attention has been paid to its culture.

At present there are numerous tea estates in existence, and the culture is being gradually increased. Three varieties of the plant have been introduced, viz., the China, Assam, and a hybrid, or cross between the China and Assam. The China plant is the hardiest, but the hybrid is the most prolific of leaf, and therefore the one most generally cultivated. The gardens on the eastern slopes, where the rainfall is the lightest, appear to yield the finest flavoured tea, but the crops are not so abundant as in moister localities. The peculiarities of Madras, as contrasted with China teas, are their

much greater strength and stronger aroma, qualities which have created a great demand in England for mixing and improving China teas.

TABLE SHOWING the PERCENTAGE of INDIAN TEA and CHINA TEA TAKEN for HOME CONSUMPTION in the UNITED KINGDOM DURING the LAST TWELVE YEARS.

Year.	Indian.	China.	Year.	Indian.	China.
1877	19	81	1883	34	66
1878	23	77	1884	37	63
1879	22	78	1885	39	61
1880	28	72	1886	41	59
1881	30	70	1887	47	51
1882	31	69	1888	51	49

In the last three years Ceylon Tea is included with Indian.

In the year 1888—

							Lbs.
India sent us	..	..	..	..	..	..	113,004,692
China only	..	..	..	..	..	..	105,424,271

The soil along the Chundrim River in Upper Burma is eminently suitable for tea cultivation; the plant grows wild on all the hills and attains enormous dimensions.

Ceylon.—In 1843 tea culture seems to have been tried in this island, but without practical results.

In 1867 there were only 10 acres planted with tea in Ceylon; in 1876, 1750 acres; in 1885 this had increased to 102,000 acres, and the quantity of tea produced was in 1885–6, 6,750,000 lbs.

About 1876 the adaptation of the low lands of Ceylon to tea cultivation was acknowledged, and it was also proved that much which had been under coffee cultivation could be readily and profitably converted into tea-producing property. The planting of tea now began in earnest. In 1880 the export of tea from Ceylon was only 114,845 lbs., and in 1887 it had risen to 13,500,000 lbs. There are now about 200,000 acres of tea planted in Ceylon, giving employment to 1200 British managers and superintendents, and 300,000 British subjects from India and Ceylon.

In 1873 the exports of tea from Ceylon were 23 lbs., in 1885 they were 4,500,000 lbs., in 1886 about 8,000,000 lbs., and in the near future probably 40,000,000 lbs. will be exported.

The area under tea in the island is rapidly extending. Some of the plantations are but little above sea-level, while others run up to an elevation of 6000 feet. The average altitude of the larger districts is about 4000 feet above sea-level, an elevation at which the climate is pleasant and most healthy. A railway runs up into the hills and a good system of cart-roads exists, so that most of the estates are already within a day's journey from Colombo, the capital and shipping port.

The tea bushes are planted in lines at regular distances over

hundreds of acres of carefully drained land, which is regularly weeded every month. The young plants if left to themselves grow up rapidly and soon become trees, but it is necessary to reduce them to the form of a bush to obtain within workable reach the surface from which the young shoots grow, and of which tea is made. The bushes are pruned down to a height of about two feet, and begin to yield leaf between two and four years old, according to climate and other causes. The pruning process is repeated every year. Eight weeks after pruning the first flush of young shoots is ready to be plucked, and, during the height of the season, the flushes re-occur every week or ten days.

Coolies, having a small basket attached to their girdle, then go round and pluck the bud and a couple of the tender half developed leaves. At mid-day and again in the evening the leaf is weighed and taken to the factory. The leaf is at once spread very thinly on trays or shelves to wither. The time which the leaf takes to wither—to become soft and pliable without drying up—varies with the weather, but, as a rule, the leaf gathered one day will be sufficiently withered the following day.

The withered leaf is then placed in the rolling machine, an ingenious and effective machine which is driven by water or steam power. The rolling lasts for nearly half an hour; at the end of that time the leaf has become a moist mass of twisted and bruised leaves, out of which the expressed juice freely comes, technically called “the roll.”

The roll is then placed on trays to ferment or oxidize; during this process it changes from a green to a copper colour. The subsequent strength and flavour of the tea depend to a great extent upon the fermentation—a chemical process, the success of which is not entirely within the control of the planter, but depends greatly on the weather, and takes a time varying from two to six hours.

The next process is that of firing. The roll is thinly spread on trays and placed either over charcoal stoves or in large iron drying-machines, and at the end of half an hour it is thoroughly crisp and dried, and has become tea. The tea is sorted or sized by being passed through sieves of different mesh, giving the varieties of broken Pekoe, Pekoe, Souchong, Congou, and dust.

Tea cannot be made from the withered leaves picked up under the bushes in autumn. In the first place the bush is an evergreen, and, moreover, only the young shoots described above can be manufactured into tea.

Each one of the various operations connected with the cultivation and manufacture of tea requires to be carried out with scrupulous cleanliness and chemical precision, or the tea suffers in quality. Mr. J. L. Shand, of Ceylon, well observes: “The selection of land, rearing plants in nurseries, felling forest, and clearing land, the operation of planting, and the erection of the necessary buildings and machinery, are all works requiring diligent and careful supervision, and involving a considerable outlay of capital.”

The different kinds of tea—Pekoe, Souchong, Bohea, &c.—do not grow on different bushes, nor are different species of seed required for their production. The various marketable teas are all picked in their leaf state from the same bush, at the same time, by the same hand. A succulent shoot from four to six inches long runs up, when the “flush” of leaf is on, from all parts of the flatly pruned bush, and these are picked off entire, stem and leaves. The little unfolded leaflet at the top makes Flowery Pekoe; the next small perfect tender leaf, Pekoe; the next larger and more advanced leaf, Souchong; and the lowest coarsest leaf, Bohea. These leaves are all made into tea together, and the various kinds are afterwards sorted out by hand.

The broken Pekoe, which consists chiefly of the opening-bud of the leaf, gives the strongest tea, perhaps too strong a tea to be infused by itself, and a mixture of Pekoe and Souchong makes the most pleasant drinking tea. The final process is that of weighing and packing. When a sufficient quantity has been manufactured, the tea is again slightly fired, to drive off any suspicion of moisture, and packed while warm in lead-lined boxes, carefully soldered down to exclude air.

Mr. J. Hamilton, writing on the Tea Industry, states that “Ceylon tea can be laid down in London at a cost, roughly speaking, to include everything, from 6*d.* to 8*d.* a lb., varying according to yield per acre, machinery, firewood facilities, communication with Colombo, &c., and whether manure is applied to the estate or not. The average sale price per pound for all Ceylon in 1885 was 1*s.* 3½*d.* per lb., which shows a profit of 6*d.* to 9*d.* Tea from Assam cannot be laid down in the market under 11*d.* to 1*s.* per lb. Whether this rate is capable of reduction with improved facilities for manufacturing and transport is at present uncertain. Anyway, Ceylon will always have an advantage over India of 3*d.* a lb. less in the cost of manufacture, owing to especially favourable natural facilities.”

At present, too, Ceylon averages 2*d.* to 3*d.* a lb. more for the whole of her teas than India. Whether this advantage will be maintained when Ceylon exports have increased largely, will depend entirely on her power to keep up the quality of her teas, which at present are universally liked by the trade on their own merits.

It is difficult to arrive at an approximate calculation of the present area under tea cultivation in Ceylon as the acreage is so scattered. Ceylon seems capable of yielding a larger average return per acre than the most sanguine could have expected. It far surpasses the average yield on Indian estates. It is calculated an average yield of 400 lbs. to the acre may be looked for when an estate is in full bearing up country, and a yield of from 500 to 600 lbs. per acre in the low country. Some, however, are inclined to place the average yield over the whole island as low as 300 lbs. to the acre. Many estates up country already are picking their 600 or 700 lbs. per acre off trees in full bearing. At present it is premature to lay down any hard-

and-fast opinion as to what the average yield of Ceylon will be. It may safely be assumed that it will not be less than 300 lbs. an acre, and more probably will be nearer 400 lbs.; so, if the profit realised is only 3*d.* a lb. (taking tea at less than half the profit it now gives), the return, after paying all expenses, shows a profit of £5 an acre.

Tea commences to give some marketable leaf after eighteen months old, according to the locality. The planter generally sells his green leaf at first to the nearest neighbour who has machinery in operation, who readily buys it at 2*d.* a lb.

Straits Settlements.—Experiments were made in 1871 by the proprietors of the Alma estate to introduce the tea plant. They have now some twenty-five acres in bearing, and the manager, who has had large experience in Assam and other tea-producing countries, considers that the trees have grown as well as could be desired, whilst the strength and flavour of the leaf are excellent; but he adds that its success as a profitable enterprise depends greatly on an abundant supply of Indian labour.

Tea has been experimentally commenced in Perak. There are about 50 acres of Assam hybrid on the Government Hill Gardens, at elevations varying from 1600 to 3000 feet, and this is pronounced by competent authorities to be doing as well as any in Ceylon. The tea made from the leaves is also of good quality, but none has yet been cured or sent to market to try its value. There is fine land in the low country suited to tea cultivation, and what has been planted on the plains has grown luxuriantly.

The tea tree adapts itself wonderfully to varying conditions of soil and climate, and is of a very hardy nature. It flourishes at the equator and equally at a far north degree of latitude in China, where it is subjected to a severe winter, in the hot plains of India, and on the Darjeeling and Nilgiri mountains, at sea-level in Ceylon, and at an elevation of 6000 feet, affording a great choice of climate to intending investors; but a necessary condition of remunerative cultivation is a large and incessant labour supply, and extension of enterprise is often checked for want of this.

Java.—In 1826 some tea seeds sent from Decima, in Japan, by Dr. Von Sieboldt, were planted in the Botanic Gardens of Buitenzong. The plants having succeeded, the idea was entertained of commencing tea culture upon a large scale. The first plantation, of about 800 trees, was formed in 1827, and some specimens of tea from the first trees grown in the island were shown at an industrial exhibition held in 1828. A second plantation was formed at Caroet, in the regency of Preanger, the first being in the regency of Buitenzong. So successful was the progress made, that in 1833 the number of trees in the regency of Krawang was returned at more than 500,000. In Java, the best tea, with coffee, is grown at a height of 3000 to 4000 feet above the level of the sea. It is on the slopes of the mountains in the residencies of Preanger, Bagelin, and Banjoemans that the finest plantations of tea are found. The leaves are gathered after the second or third year. Up to 1842 tea was cultivated in Java exclusively on

Government account under the superintendence of its officials. There were then 13,500,000 tea trees.

The number of labourers required for the culture and preparation of the tea was so large, the supervision so difficult, and the result so unsatisfactory, that the Government resolved to relinquish some of its plantations to private individuals, undertaking to buy the tea of them at a fixed price. This resulted in an extension and improvement of the cultivation, but the purchasing price was found too onerous for the Government, and the contracts were annulled after seven years' trial. The consequence of this was that the cultivation of tea was abandoned in all but the regencies of Preanger and Bagelin, and the districts of Buitenzong and Krawang. It was found that private individuals were able, when left to themselves, to grow on more favourable terms than the Government, for, while the former obtained 2 lbs. of tea from seven or eight trees, the latter only obtained 2 lbs. from thirty-three trees. In 1860, therefore, the Government gave up its last plantation in the regency of Bagelin. Now that it is left to its own energy, without Government control or aid, it succeeds better.

In 1854 the island had 14,307,768 tea plants, from which 1,547,458 lbs. of tea were delivered to commerce. Nothing can be more attractive than these tea plantations, each containing from 70,000 to 100,000 trees, and giving occupation to from twenty-five to thirty families of native labourers. The seeds are sown in nurseries, from which the young plants are planted out in line at a distance of about four feet from each other. The tree is not allowed to exceed one and a half to two feet in height. The gathering of the leaves takes place in the rainy season at the age of two years. Both black and green tea are made. That known as Pekoe is made from the leaves gathered at the top of the plant and the extremities of the branches. It takes the leaves from eight trees to make two pounds of tea.

A tea planter in Java writes:—

"I find tea pays better than coffee: in two years crops come in. My tea seed I get from Bengal, hybrid Assam. I commenced planting tea two years ago; all the land drained, lined, manured with ashes and buffalo manure, holes $3\frac{1}{2}$ feet deep, $3\frac{1}{2}$ feet wide. The tea roots penetrate very deep into the soil. One man makes five to seven holes a day; each hole costs five cents, 5 by 5 feet, so all the land is worked at once, and no bother afterwards. I have about 70 acres planted; seed, Bengal hybrid. I am now going to try the indigenous Bengal, which is hardier. Elevation, say 700 or 800 feet, but much moisture. Plenty of women to collect the crops; pluck leaves every thirty-five days, higher up in the hills, forty-two days. I have now thirty chests each time; before June shall have fifty chests each crop. My neighbours plant $2\frac{1}{2}$ by $2\frac{1}{2}$; I don't approve of this. They make small holes, say, 100 to 120 by a man in a day. I say, if you do a thing, if it is worth doing, do it well. I look after everything myself, so have plenty of work and no mistake. I avoid slopes; use level land."

At first the culture of tea, like that of coffee, was not successful

in Java. But by choosing suitable land, and calling in the aid of the Chinese for the cultivation and manufacture, it has prospered. The cultivation is now free, and no longer a State monopoly.

It is now cultivated in the thirteen residencies; but the principal establishment, where the final preparation is carried on, is in the neighbourhood of Batavia.

The first gathering of leaves is in the third year, in the dry season, from January to August.

In Java the tea plant is cultivated in the elevated regions, where the climate is temperate, chiefly on the slopes of the mountains in the residencies of Preanger and Bagelin. Ten years ago the production was about 4,500,000 lbs.

The plantations of tea in Java have not increased, but more care has been paid to the culture and manufacture. The average annual export in the ten years ending 1886 was 2,627,138 kilogrammes, or 5,750,000 lbs. In 1884 it was 10,853,607 lbs., and in 1885, 7,393,391 lbs.

TEA EXPORTS from JAVA and MADURA, in KILOGRAMMES.

1872	..	..	..	2,114,206	1880	..	..	..	2,518,544
1873	..	..	..	2,075,747	1881	..	..	..	2,203,000
1874	..	..	..	2,242,025	1882	..	..	..	2,692,000
1875	..	..	..	2,179,791	1883	..	..	..	2,677,000
1876	..	..	..	2,405,581	1884	..	..	..	2,553,000
1877	..	..	..	2,553,855	1885	..	..	..	2,423,195
1878	..	..	..	2,790,557	1886	..	..	..	3,258,000
1879	..	..	..	2,602,235					

Besides the above; 700,000 or 800,000 kilogrammes are shipped from other parts.

In 1885, 5,020,375 kilogrammes of tea were imported into Holland, nearly half of which was received in Rotterdam. The consumption of tea in Holland is a little over 1 lb. per head.

JAVA—CHESTS of 40 KILOGRAMMES.

Years.	Exports to			Total.
	Netherlands.	England.	Australia.	
1877-78	58,500	23,000	4,600	86,100
1878-79	23,600	25,500	6,600	55,700
1879-80	32,300	31,000	1,400	64,700
1880-81	37,200	12,600	3,400	53,200
1881-82	40,300	10,100	6,900	57,300
1882-83	43,900	30,000	2,400	76,300
1883-84	31,900	36,200	2,200	70,300
1884-85	23,100	47,500	4,300	74,900
1885-86	22,300	41,600	1,300	65,200
1886-87	32,300	48,000	2,900	83,200

In *Japan* tea is cultivated from Kiusieu to Nippon, up to the 39° of N. lat., but the zone found most favourable is from the 30° to the 35°, especially in the regions on the coasts of the interior

sea. The total annual production is estimated at 40,000,000 lbs., and the shipments reach 30,000,000 lbs.

Tea was first cultivated in Japan in the beginning of the 13th century. Owing to the particular condition of the climate on the west coast, the tea plant in Japan grows much farther north than is generally admitted, viz., to the 38th degree. Tea seeds are frequently used in Japan for making a very fine oil.

Twenty years ago we used to receive three to four million pounds of tea from Japan; now it has dropped to a few thousand pounds, being replaced by Ceylon and Indian teas. The exports of tea from Japan now average 32,000,000 lbs. The exports have been as follows:—

Year.								Catties of $1\frac{1}{2}$ lb.
1872	..	..	..	..	..	..	..	13,000,000
1882	..	..	..	..	..	..	..	23,589,099
1883	..	..	..	..	..	..	..	24,141,049
1884	..	..	..	..	..	..	..	23,233,965
1885	..	..	..	..	..	..	..	26,819,549

It is nearly all shipped from Yokohama, and principally to the United States. The exports thence were, in 1883–84, 20,407,740 lbs., and in 1884–85, 20,858,248 lbs. A considerable stimulus has within the last three years been given to the cultivation of the tea plant, with a most profitable result to the growers. The area of tea plantations is rapidly increasing, and the young shrubs planted are now coming into full bearing.

The production of teas for export is steadily increasing in Japan, and it is probable that the tea of that country, which is pure, delicate, and wholesome, will maintain its hold upon the taste of the Americans, who have learned to like it.

Australia.—Baron Mueller considers that the extensive fern-tree gullies of Victoria would be exceedingly suitable for this culture.

“The tea shrub was raised in the Botanic Garden at Melbourne in some quantity as far back as 1859, and since that time, with the sanction of successive Ministries, has been rather largely distributed to those of our colonists who wished to experiment on it; many plants were, amongst others, also sent to the Industrial School Dépôt at Sunbury. In early age the plant is, however, somewhat tender, and apt to succumb to dryness; yet not only still at the Botanical Garden, but also in many other of our main public plantations, as well as in private gardens, there must be now ample means to obtain seeds for further dissemination or test. The growth of the plant alone for seed would prove for some years remunerative. Already in 1862 I brought the first sample of Australian tea prepared from bushes grown by myself, before the London International Exhibition of that year. Subsequently other samples from a laboratory constructed by me for work of this kind, and until the last two years under my control, were exhibited at the various great international gatherings of industrial products, and one of these specimen lots may likewise be seen in the Melbourne Technologic Museum.

“A damp warm climate, with rains to the extent of 70 or even

100 inches, well spread over the year, and copious in the spring, is above all adapted for tea culture; with a view to the amplest return, tea bushes should never be shrivelled up by hot winds, or oppressed by lasting frosts. Rich forest land in its virgin state is preferable to any other. Wide valleys with gentle slopes or undulations, or slightly elevated level lands with natural drainage, are far more eligible than steep hill-sides, because the working of such lands is less expensive, while the risk of any denudation of the roots by washing away of earth on declivities is avoided. Light loams of a reddish or yellowish colour, crumbling throughout, of several feet depth, with a surface stratum of decomposed forest foliage, is insisted on as the most desirable for the largest and most lasting yields; nevertheless, in many other soils the tea bush will thrive."

Baron Mueller further observes:—

"I believe that products would be obtained in our ranges, superior in flavour and strength, especially to the commoner sorts in general use; hence our competition with China and Japan (which countries have singularly long enjoyed the monopoly in this trade) should be particularly in the more precious sorts of tea. The presence of so large a number of the Chinese people in Australia seems to indicate much facility for turning their home experience in this industry here to account. Probably neither in China nor in India can land for forming new tea gardens be obtained at such small cash outlay as in this and the other Australian colonies. The annual mean temperature of Melbourne (about 58° Fahr.) is slightly higher than that of the Darjeeling and Neilgherries tea districts (56° Fahr.), but at Assam it is 74°, and so at Cachar in the principal tea regions. Though we possess in Victoria warmer tracts of country (even so far south as Portland, the mean being 61° Fahr.) than that about the metropolis, yet we cannot expect to realise tea harvests equally heavy as those for which Assam is already so famed; but, like every other crop, this one cannot be grown in various parts of the world under conditions alike excellent, and we must content ourselves with lesser results. The rainfall at Melbourne averaged for some years 26 inches, but rose in 1872 to 32 inches. At the eastern boundary of Gippsland it was, however, recorded in 1871 at 54 inches. At Schnapper Point it was, in 1872, 43 inches; in 1874, 39 inches. At Daylesford, 1872, 42 inches; 1874, 40 inches. At Cape Otway, 1874, 42 inches. At Hastings, 1874, 45 inches. At Warrandyte, 1872, 48 inches; 1874, 41 inches. At Berwick, 1872, 51 inches; 1874, 42 inches. In our fern-tree gullies it would in all likelihood, as a rule, be much more. Want of moisture cannot militate, therefore, against the success of tea-growing in our forest glades, although in Assam the rainfall fluctuates between 70 and 95 inches. At Darjeeling it is still heavier—about 129 inches; but the enormous precipitation of moisture at the latter place is acknowledged to be adverse to the best development of tea there. It is quite possible that here in our colony every geologic formation and every climatic tract, though otherwise not unfavourable to this culture, will not

yield products of equal value in flavour and taste, even if the most careful methods were adopted to secure a proper curing of the leaves."

Queensland.—Tea grows luxuriantly on the coast, but the plant, in order to develop the full flavour of the leaf, seems to require the hibernation, or rest for a period, that cannot be had in a climate where the warmth and stimulus to growth are constant. The cultivation and subsequent manufacture connected with the tea and coffee plants require, at certain seasons, a considerable supply of light labour.

Jamaica.—In 1868 a case of tea plants was sent out from Kew to Jamaica, and placed under the care of Mr. Thompson, the island botanist at St. Andrew. The idea has been formed, on good scientific authority, that the soil and climate are so well adapted that the tea plant will flourish there.

For the hills, the tea plants already established here, being the Chinese kind, are admirably suited; but for the parish of Portland, with its warm moist climate and splendid rich valleys, the Assam kind would appear to be the most suitable. With indentured coolie labour, and an experienced planter from Ceylon and India, tea might be grown in the West Indies and placed on the market at a cost not exceeding $7\frac{1}{2}d.$ to $8d.$ per pound. The advantages as regards tea are that no sun is absolutely required, and no water. The tea plant is most hardy; it will grow in the old soils of abandoned coffee fields, as proved in Ceylon, and it will thrive in Jamaica at all elevations, from about 80 feet to nearly 6000 feet. To secure the best results, it is advisable to plant tea in moist, warm, and somewhat sheltered districts.

Some 600 plants of the Assam variety were introduced into Jamaica from Calcutta, through the Kew Botanic Gardens, in 1868. Since the establishment of this small plantation, at a height of 4500 feet above the level of the sea, the plants have become naturalised, and can be propagated to any extent. This plant grows with much vigour in the humid mountains, in localities far too damp for profitable coffee cultivation. At different Exhibitions the judges have considered the tea produced of good quality. It has therefore been clearly demonstrated that tea of excellent quality can be produced in the Jamaica mountains.

Trinidad.—Tea would undoubtedly grow profusely, but considering the enormous acreage now under cultivation in China, India, and Ceylon, and which is being still more largely extended in the latter place, and which threatens in a short time to glut the markets of the world, and considering also the scarceness of labour in Trinidad as compared with the three countries named, it would probably be prudent to leave tea alone.

Brazil.—In 1810 a number of tea plants were introduced into Brazil, with a colony of Chinese to superintend their culture. The plantation was established near Rio Janeiro, and occupied several acres. It did not, however, answer the expectations formed of it; the shrubs became stunted, cankered, and moss-grown, and the Chinese finally abandoned them.

A report by M. Guillin was presented about a quarter of a century ago to the French Minister of Agriculture and Commerce on the culture and preparation of tea in Brazil. It entered very minutely into the incidents of temperature and cultivation, and disclosed the important fact that the tea plant grows luxuriantly with the coffee and other valuable plants of the equatorial regions, and even on low-lying lands on a level with the sea, and exposed to the full rays of a burning sun.

In Brazil, the culture of tea has been extended in the provinces of San Paulo, Minas, Parana, and Rio Janeiro. Some few years ago Brazil produced about 300,000 lbs. of tea annually, and the quantity has since augmented; but it will never send much into commerce, as it has not labour to spare from coffee culture, and Yerba maté tea is preferred for local consumption. The Brazilian tea resembles, it is said, in flavour, the tea of Japan, and possesses a fine aroma.

North America.—The American Commissioner of Agriculture reported some four years ago that tea culture was just becoming a feature of importance in the Western and Southern States, and that in a few years enough tea would be grown in those sections to meet the home consumption. The Department sent out to various parts of the country over 50,000 plants, nearly all of which have lived, and is now distributing seeds from plants raised in South Carolina.

The adaptation of various sections to the growth of the plant has been abundantly demonstrated, and plants from seed grown in the Southern States have, from time to time, been raised by the Department of Agriculture for distribution. So far back as 1848 the late Dr. Junius Smith abundantly proved that the mountains of South Carolina would produce and mature tea, although it was there subjected to severe freezing and heavy falls of snow. It was grown in Florida and Georgia, and even farther north. In the grounds of the Department at Washington the plant passed through a very severe winter without having been absolutely killed.

In the present state of the labour market the Americans cannot be expected to proceed on the plan of the British in the East Indies and establish large plantations. It would not pay to do so; but the intelligence of the farmers of the country, and the improved agricultural machinery in use, will render completely easy there what proved an insuperable difficulty in India, viz., the growing of tea for family use. The apathy of the Hindoo races, their dislike of anything new, and the fact that tea is not their popular beverage, militated against the production of tea for their own wants in anything like a general system. Isolated points occur where they acquire a taste for tea, and then they grow and manufacture it very well, but they cannot accustom themselves to cultivate it with any care, unless under European supervision.

Experiments in raising the tea plant have been tried with more or less success in Tennessee and South Carolina, but it has been reserved for California to attempt the culture on a large scale. A

German gentleman, Herr Schnell, recently brought a small colony of Japanese to the State. Schnell had been a resident in Japan for ten years, was formerly connected with the Prussian Embassy, and was later on in the Japanese service. On arrival, he purchased a "ranch" (farm) of 600 acres, near Placerville, El Dorado county. He brought with him 6,000,000 tea seeds, and immediately planted out a number of them; but only a moderate quantity have thriven.

The tea shrub in California is an evergreen, from 4 to 6 feet high, with a straight stem and irregular branches, the former of a bright grey colour, while the latter is chestnut, the wood being hard, with a peculiar odour. The leaves closely resemble those of the wild rose, the colour being bright green, but deepening with the advance of the season. The blossoms, at first of a rose colour, assume, when full blown, the colour of a tea rose; when the flowers fade away, they leave a small fruit which contains the seeds, these are planted in rows from 4 to 6 inches deep. The proper time for planting is stated to be in November or December, the sprout appearing in about a month. Within six months the plant reaches a height of 14 inches, when the leaves are stripped off and placed under manipulation. The trees are annually trimmed down to a height of 3 feet, and it is believed they produce a good yield for upwards of thirty years. The only question as to the success of tea in California is that of labour.

The following instructions have been issued for guidance in North America:—

Soils.—Almost any good, free soil, upon which water does not stagnate, will grow the plant. A good garden soil will produce tea in perfection, but it will be best to describe a tea soil as a sandy, chocolate-coloured loam, containing an abundance of humus or decaying vegetable matter in a fit state for absorption by the roots.

Propagation by Seeds and Cuttings.—The first thing for the experimental grower is to understand the best manner of raising his plants. This is simple, the only precaution necessary being to use fresh seed. If tea seed is kept for any length of time out of the ground it turns rancid, as the chestnut and many other oily seeds are apt to do. Ripe seed is known by its dark chestnut colour. As soon as procured it should be laid upon a hard surface and covered with 2 or 3 inches of rotten leaves, decayed hops, or almost any convenient vegetable material. In this position the seed will germinate, and when the sprouts are 2 or 3 inches high the young seedlings may be transferred to beds. The plants can be set out in nursery beds at 3 or 4 inches apart, according to the time they may possibly remain. If they are "pricked out" into beds in the spring, to be finally planted out in the fall, or in the fall to be planted in the spring, 3 inches will be ample; much still depend upon the time when the seed is received. If, however, the plants are likely to remain in the nursery beds for more than six months, it will be best to allow 4 inches between plant and plant. An easier method is simply to plant the seed in the beds in drills, from 1 to 2 inches deep and 4 inches apart, in a half shady

position ; but vacancies from bad seed cannot well be avoided by this plan. By germinating the seed a full nursery is obtained with very little extra labour. The seed may also be planted in hills, as gardeners plant melons, the hills being 5 feet apart. But here they must be weeded all the time, and, as an acre of ground would have to be gone over for some 1742 plants, much extra labour will be entailed by this method of planting the seed where it is to remain. Better to treat it as cabbage, nurse in beds, and afterwards plant out. It may be useful to suggest here that it would be well for the nurserymen to turn their attention to the raising of tea plants for sale in the localities where they are known to thrive.

The only attention a bed of young tea plants requires is the routine work of weeding, occasional watering in dry weather, and possibly light shading with branches of trees in leaf, cut into lengths of about a foot, and stuck among the plants until they become established. If the pricking or transplanting out is done in cloudy, showery weather, this labour may be saved. The propagation of tea by cuttings is a tedious and often very unsatisfactory process. The writer has put down many hundreds of thousands of cuttings, with the view of perpetuating superior varieties. The returns of rooted plants varied with the season from 10 to 75 per cent. This method of propagation is expensive, tiresome, and unsatisfactory. A much better plan will be to secure a good pure lot of plants, and keep them separate as much as possible. I would suggest the propriety of the Department of Agriculture, and others who have the distribution of plants in their hands, sending one "strain" of plants alone to given localities as much as possible: the Assam kinds to hot and moist localities, and the Chinese type to drier and more elevated situations.

The Preparation of the Soil for tea should be precisely the same as the preparation for any other farm crop. Secure the best possible tilth, manure well, preferably with vegetable manure. A crop of any cheap seeded legume ploughed in would be excellent, but any available manure in which straw is incorporated would answer. Plough deep and well ; even subsoil, where the experiment is intended to be thorough, and the land will bear it. Harrow and cross harrow. Mark out the land 5 feet by 5 in straight lines, as for maize, and it is ready to receive the tea plants, which plant at the intersections of the scoring. Or, if it be determined to grow the tea with some other crop—for instance, onions, turnips, tomatoes, melons, cucumbers, pea-nuts, low-growing pease, celery, or almost any crop which will not shade the plants—then the latter may be planted either as subdividing hedges at any distance apart to suit the taste, or they may be planted within the fences. This plan is very extensively practised by the Chinese, and is a great economy of labour, since then the tea needs scarcely any special cultivation other than that given to well-kept hedges generally. The plants may be almost any distance apart in the rows, between 1 foot and 4 feet. The hedges may be clipped, but

a flat top is the most productive form as regards yield of leaf. I am supposing that from one hundred to five hundred or more plants are to be planted for family use. When fully started, the plantation of tea merely requires to be kept moderately well weeded, and in no case must weeds be allowed to overtop and shade the tea; it is a crop requiring the full sun.

Planting.—No especial directions are necessary further than to say that the plants must, if possible, be planted in the spring, in showery weather, and not too deep; anyone who can plant a garden with success can manage a tea plant. A little shade may be useful if hot, dry, sunny weather ensues; a few small boughs, stuck round the plants, are all that is needed to prevent intense evaporation from the soil and plants. I may mention that in deep soils the tea plant has a tendency to form a long, bare tap-root, somewhat resembling a root of salsify or carrot. The directions given as to germinating the seed on a hard bottom were intended to obviate this tendency to form a long tap-root, and start the plant in the way it should go, forming fibrous roots; but if perchance a long tap-root is formed in spite of all precautions, then, in transplanting, it must be got out as entire as possible, and more care will be necessary until the plant has commenced to make new roots and growth in its new position. The kind of culture required while the tea plants are reaching utilisable condition may be almost entirely performed by horse labour, if the tea is grown in with other crops.

I am not urging the formation of extensive plantations as yet, and, consequently, I cannot pretend to regard the setting out and tending of an ornamental hedge as anything but very pleasant pastime for the intelligent farmer in his leisure hours. The base of the plants should be kept free of weeds, and when 6 inches of growth is made, the extremities of the shoots and the terminal bud and three leaves below should be pinched out; if this pinching is done in the growing season the operator will not only be bringing his tea bush into a spreading shape by the process, but will also be taking off the very article which goes to make the bulk of the teas of commerce. This pinching of the 6-inch shoots should continue until the plants reach their third year, when a sufficient quantity of leaves will be obtained for manufacturing purposes.

Picking of the Crop.—When the shrubs are about three years old there will be a sufficient quantity of leaves obtainable to warrant a muster of the women and children of the farm, each of whom should be instructed to nip off the young and tender growth with the finger and thumb, at the point. The three leaves and terminal bud, together with the tender stalk, make the very finest class of Souchong teas, often ranking, if well made, as Pekoe Souchong, and worth at least 4 dollars per pound. If a coarser tea is desired, the young growth may be nipped out at the point. Some may question the propriety of picking the stalk, but it is as tender as the leaves, and is invariably used except in Caper and Gunpowder teas. The leaves may be gathered in the apron or anything else; there is no more mystery about the matter than there is about

gathering pease, or any other crop, it being only necessary to select the young growth, for the coarse leaves are not worth gathering; they will not make good tea.

Having briefly treated of the picking process, I will give a variety of methods by which tea is made. It takes on an average 4 lbs. of raw leaf to make 1 lb. of tea.

Process No. 1.—1. Picking the leaf; 2. Spreading 2 inches thick on mats, &c.; 3. Tossing in the hands (as hay); 4. Tossing on flat trays; 5. Examine for bruised red spots; 6. Place thin on mats, &c.; 7. Cover with cloth until fragrant; 8. Roasting on pan; 9. Rolling under the hands; 10. Drying over charcoal.

Process No. 2.—1. Picking the leaf; 2. Spreading out thinly; 3. Tossing in the hands; 4. Roasting; 5. Rolling; 6. Roasting; 7. Rolling; 8. Roasting; 9. Rolling; 10. Partial drying over fire; 11. Exposure to the air; 12. Picking out coarse leaf; 13. Final drying; 14. Packing.

Process No. 3.—First day and night: 1. Picking the leaf; 2. Spreading out thinly. Second day and night: 3. Exposure to air and tossing; 4. Roasting at 180° to 200° Fahr.; 5. Rolling out juices; 6. Roasting on pan at 160°; 7. Rolling out more moisture; 8. Spreading out thinly. Third day and night: 9. Partial drying in sun or otherwise; 10. Picking out stalks, &c.; 11. Final drying. Fourth day, if convenient: 12. Sifting out dust, &c.; 13. Packing.

Process No. 4.—First day and night: 1. Picking the leaf 2. Spreading out thinly. Second day and night: 3. Exposure to sun, turning over, tossing, and picking out of coarse leaves; 4. Panning, at 180° to 200°; 5. Rolling out juices; 6. Fermentation in heaps; 7. Spreading thinly. Third day and night: 8. Partial drying; 9. Picking out stalks; 10. Final drying. Fourth day, if convenient: 11. Sifting; 12. Packing.

Process No. 5.—1. Picking the leaves; 2. Wither in sun two hours; 3. Cool in shade one half hour; 4. Toss and clap in hands ten minutes; 5. Cool one half hour; 6. Toss ten minutes; 7. Cool one half hour; 8. Toss ten minutes; 9. Roasting or panning; 10. Rolling; 11. Roasting; 12. Rolling; 13. Final drying; 14. Packing.

Process No. 6.—1. Picking the leaf; 2. Roasting; 3. Rolling; 4. Exposure to the air; 5. Final drying on the pan; 6. Picking out coarse leaf; 7. Sifting; 8. Packing.

The foregoing methods have all been practised by the writer, and they will all produce first-class tea in certain conditions of the weather. No two days' work can be precisely alike as to the *time* the various operations require, any more than the operations of the hay-field occupy precisely the same time from year to year, but this is not important. The great thing to understand at the outset is the principle of tea manipulation, and, this once mastered, the practice may be modified to suit everyone's circumstances.

The difference between black and green teas is entirely due to manufacture. Black tea is subjected to the oxidizing influence of the atmosphere, often for a considerable time; great chemical

changes ensuing. The tannin, volatile oils, extractive matter, and sometimes the theine are very much toned down.

Green teas undergo great changes also from the raw state, but the preservative qualities of moderate degrees of heat are brought to bear upon the leaves before they have been acted upon by the atmosphere, and the above chemical constituents, together with the colouring matter, are better preserved than in black teas. Black teas are bruised, beaten, and tossed before drying; green teas are not. Black teas are like a well-bruised apple, laid over for a day or two and then dried in an oven. Green teas are like a sound one, dried in like manner. These are the chief differences; but to make the matter more plain it will, perhaps, be best to briefly state the method of procedure and the utensils required.

Tea for family use, either black or green, may be made if the farmer or other operator can muster a cooking stove, or even a fire on the floor, and a brick or two, over which to set an iron or a block-tin pan, measuring 2 feet 4 inches in diameter and 7 inches deep; this is, perhaps, the most convenient size, but a smaller will answer perfectly well as long as the hemispherical form is maintained. This is the roasting pan, and in it the raw leaves are heated so as to cause them to exude their moisture. The pores of the leaves open with a series of miniature explosions, causing a sharp crackling sound; this is a tolerable test of the heat; that is, the leaves should crackle, but unfortunately they will do so when the pan is red hot, and liable to burn out all the goodness from the leaf.

Whatever heating medium may be employed, whether sun or fire, or their combinations, the leaves should be perfectly soft and pliable before they can be rolled without breakage. They should be moist enough to stick together. When in this state the leaves are thrown on a table on which a bamboo or rattan mat is nailed. The Indian matting used for covering floors will answer, or the table may be shallowly grooved. A board to be worked by the hands may be grooved in the opposite direction, the whole arrangement being somewhat like a pill-making machine on a large scale. Or a machine (of which there are several) may be used, where the operations are sufficiently extensive to warrant its use.

Rolling.—This process has probably attracted more attention than any other part of the manufacture. The object is really to extract and press out the bitter juices (probably tannic acid, &c.), and it accidentally happens that the leaf receives the various twists seen in the commercial teas. The Chinese manage this rolling almost entirely by the hands and feet. A ball of leaves is taken in the hands and rolled backward and forward, on the table, the pressure used being considerable; the leaves should become quite saponaceous, and when a quantity of juice is pressed out, and the leaves twisted, they may be pronounced properly rolled. It is a good plan to shake them out thinly after rolling, that the action of the air may evaporate the juices; and, in the case of black tea, oxidize the leaf. Some operators allow the leaves to stand in balls for a time, others warm them over the pan again; some place them in the

sun, others in the shade; some place them in heaps to ferment, both before and after rolling. In short, the various methods by which good tea may be made are simply innumerable, but the principles of desiccation and manipulation must not be violated. What those principles are must in nearly every case be determined by practice; for beyond the recapitulation of the process as given, little more is known. I have frequently proposed the analysis of the leaves of tea in their raw state to the Government chemists in India, but I believe it has not yet been undertaken; consequently the effect of exposure, heat, and pressure upon the leaves can only be conjectured. It would probably aid the inquiry very materially if a good manipulator could co-operate with a careful analytical chemist, who, for the sake of science, would be willing to investigate the various changes produced by manufacture.

The business of the farmer, after rolling and expressing his tea in various ways, suited to his fancy or convenience, will be finally to dry it over charcoal fires or on the iron pan. The latter will invariably produce a tea of stronger quality, partaking more or less of the characteristics of a green tea, even though black in colour. When the tea is thoroughly dry it may be packed in wooden or in tin boxes, always taking care they are perfectly dry and air-tight.

The cultivation of tea has been introduced into the Fiji Islands, Natal, and the Straits Settlements; the growers in all these colonies being satisfied that the yield per acre, and the quality of the manufactured leaf, justifies further extension, though the enterprise is still in comparative infancy.

Fiji.—The cultivation and manufacture here is quite of recent date. The tea manufactured on the first estate gained such universal favour that it sold readily at from 2s. to 3s. a pound, and the demand is at present far in excess of the supply. There were about 300 acres under tea, and the production in 1885 was $2\frac{1}{4}$ tons; since then it has increased rapidly, and in a few years will be able to supply the Australian markets.

Natal.—A small number of plants were sent from Kew to Natal of the China variety, and shortly afterwards an immigrant ship conveyed some seed from India, which was procured by the Association of Planters, and distributed through the country. The growth has been successful, and a large tract of land is being taken up for extension, and the local demand for the markets of the Cape Colony, Orange Free State, and the Transvaal, which now take up a considerable quantity of China tea (for the inhabitants are tea drinkers) will be supplied from this source.

Some ten years ago, on the decline of coffee, tea growing was entered on by a few, and there are now twelve planters who have 600 acres under culture, which yielded 31,000 pounds in 1885, and all this formed a local consumption. The tea possesses fine flavour and strength, and promises to make its way on its own merits.

YERBA MATÉ, OR PARAGUAY TEA.

Yerba maté is a product which, although it does not enter into European commerce, deserves notice from its extensive consumption in many of the South American States. In the former edition of the work full details were given of the mode of collecting and preparing the leaves, &c., and it is therefore only necessary now to give a more abridged description. The yerba maté is obtained from some species of holly, which have been well described by Mr. J. Miers in a paper on the history of the maté plant, in the 'Transactions of the Linnean Society.'* He shows that besides the *Ilex Paraguariensis*, St. Hil., there are several other species and varieties employed. Dr. H. Demessey also published a good account of it in his 'History, Physical, Economic, and Political of Paraguay,' two vols., Hachette, Paris, 1865. The portion relating to maté or Paraguay tea was also published as a separate treatise, with illustrations, during the Paris Exhibition, 1867, by Bouchard-Huzard. Robertson, in his 'Letters on Paraguay,' London, 1839, vol. ii. p. 134, gives some interesting details, but it is unnecessary to go back to former years; I prefer to give the present aspect of the trade.

In their wild state the trees are about the size of orange trees. The trunk is from 2 to 3 feet in circumference, and has a smooth whitish bark, and the boughs, which resemble those of the laurel, are leafy and tufted. The leaves are evergreen, and when full grown are about 4 inches long, thick, glossy, and crenate at the edges, of a dark-green colour above, and paler underneath. The flowers are small and white, growing in clusters. The berries are red, very smooth and similar to the Christmas holly. The leaves of this *Ilex* yield the same bitter principle, theine, which is found in the Chinese tea plant. Although the former may not afford so much of the agreeable narcotic oil as the latter, in consequence of the careless and primitive manner in which they are collected and prepared for use, yet they produce a most agreeable and refreshing beverage, which forms the staple drink of the South American Republics.

As far back as the seventeenth century the yerba maté was commonly drunk throughout the State of Paraguay. There can be little doubt but that the aboriginal Indians taught the use of this tea to their Spanish conquerors, and the early Jesuit missionaries planted great numbers of the tree before their expulsion, since which time its cultivation has been neglected. The expeditions to collect and prepare it start from Assuncion, the capital, to the yerba groves, a distance of 200 miles, and are generally composed of forty to fifty persons mounted on mules, having with them other mules and bullocks. On reaching a locality where the trees are abundant, wigwams are erected and the *tatacua* constructed. This consists in clearing a small space of ground, the soil of which is

* Also in 'Annals and Magazine of Natural History,' 1861, No. xlvii., p. 389.

then beaten down with heavy mallets until it becomes quite hard and level; at the four corners of this space sticks are driven into the ground, from which a sort of net made from strips of hide is stretched, a fire is kindled beneath, and the leaves on the boughs, as they are brought in from the surrounding forests, are scorched by being placed on the net, care being taken that no ignition takes place. The scorched leaves and small twigs are then pulverised into a coarse powder by means of a rude wooden mill, and frequently stamped with blocks into dust, after which process they are ready to be weighed and put up into packages for export. Half a bullock's hide in a green state is used to form a kind of sack to hold the tea, being first sewn up at the sides. The tea is then pressed down until it is quite full, the mouth is then sewn up, and the package, which usually weighs from 200 lbs. to 250 lbs., is left to dry and tighten in the sun for a few days, until it becomes as hard and impervious as a stone. Such a mode of collection and preparation is indeed primitive, and the twigs impart a woody flavour to the tea, otherwise very agreeable.

In Paraguay this tree combines, as it were, the properties of cultivated and wild plants. Indigenous to the country, the tree forms entire forests called "yerbales," in the central, eastern, and northern regions of the Republic. The Jesuits having formed vast plantations of it round their residences, these have continued, and their produce forms in what are still called *Misiones* the principal article of commerce at the present day. The Government monopoly of the sale of yerba, and a heavy duty imposed on its export, formed at one period the principal source of revenue in Paraguay.

There appears to be a considerable difference in the quality and estimation of the maté, according to the locality from which it is derived; whether this arises from the difference of the plant or mode of preparation does not appear.

That of Paraguay is the most bitter and aromatic of all, and the most esteemed; it yields four times the quantity of infusion that the maté of the *Misiones* or of *Paranagua* does. Hence, although dearer in price, it is the most economic. A coarse kind is made in *Parana*, *Brazil*, from the leaves alone, and these being unpulverized, are used in the same way as Chinese tea.

At first Europeans do not like maté, it having a herby and somewhat bitter taste, but among the inhabitants of the South American States it is a much prized article of luxury and necessity, and is the first thing offered by them to their visitors; indeed, their tables are rarely seen unoccupied by it; and the "gaucho" of the plains will travel on horseback for weeks, asking no better fare than dried beef washed down by copious draughts of maté. The demand being great and increasing, there is unfortunately continually going on a rapid destruction of the tree. The Jesuits foreseeing this, started large plantations in Paraguay, and at their branch missions in the provinces of *Parana* and *St. Pedro do Rio Grande*, some of which still exist and furnish the best tea made; and of late years some of the landowners, sensible of the short-sighted policy pur-

sued, have established many plantations with the best results, as the quality of the tea improves with the cultivation of the tree.

It is difficult to get at any consecutive or reliable returns for the entire traffic in this commodity, the production of which is carried on in such a desultory and rude manner, and extends over so vast an area of wild country. A careful consultation of the official returns of the several Republics and of Brazil, as well as British consular reports, enables me, however, to make an approximate estimate of the trade and consumption.

Forty thousand arrobas (or 10,000 cwts.) were imported into the Argentine Republic in 1870. In the next two years the consumption was as follows in the Argentine Confederation:

Description.	1871.	1872.
	lbs.	lbs.
Paraguay Yerba	260,000	3,356,000
Brazilian „	17,688,000	23,506,000
Total	17,948,000	26,862,000

The total consumption of yerba in the Argentine Republic in 1872 thus averaged 13 lbs. per head of the population, against 2 lbs. of coffee, and only $\frac{1}{4}$ lb. of tea. Altogether, nearly 27,000,000 lbs. appear to have been consumed in the Republic during that one year. Surprising as this amount is at first sight, it is explained by the fact that yerba constitutes the only vegetable nourishment of many classes of the community. In the rural districts, as well as the smaller towns, this herb is considered a regular form of diet, and not, like tea in England, a mere accompaniment of the breakfast table. The method of manufacture is to mix ordinary sugar with the decoction of yerba until a thick syrup is produced, when it is ready for drinking. Probably the nourishing properties attributed to the herb by the natives are derived from this mixture of saccharine matter. As might have been expected from the prevalence of this practice, the annual consumption of sugar in the Argentine Republic is enormous. Viewing the extreme popularity of yerba in South America, it seems strange that it has not yet been introduced into Europe, as an addition to the food supply.

Maté is a dietetic product little known in Europe, but the use of which is general in the States of South America and certain provinces of Brazil, where its therapeutic virtues are considered equal to its nutritive properties. It contains principles which are considered equal to those of tea, and more active in their analogy than those of coffee.

The tree attains a height of 15 to 18 feet, and in Brazil grows on the wooded regions of Rio Grande, Parana, and the province of St. Catherine. The importance of the local consumption is shown by the custom returns, and there is also an export of 65,000,000 lbs. annually, principally from Parana, where the consumption is

about 9,000,000 lbs., while in Rio Grande do Sul the provincial consumption is four times as much, not counting large quantities consumed by the aboriginal races.

Maté is held in high estimation by the pastoral population in the agricultural districts, replacing advantageously wine and spirits. Strangers resident in Brazil also take to it and appreciate it. From various analyses it is found that maté contains, like coffee, three main principles, an alkaloid, essential oil, and gum resin. The quantity of alkaloid is said to be larger than in tea and coffee, the proportion of gum relatively more considerable. It has the double advantage over tea and coffee, that it does not affect the nerves, and is much cheaper, being sold at 2*d.* to 4*d.* per lb., and 1 lb. will produce 20 quarts of infusion. If it were better known in Europe, a large commerce might be carried on in it.

Senor Arata who has devoted much time and skill to the subject, has given the result of some chemical examinations he made. Among the soluble principles is an average of 1.300 of caffeine. The quantity, however, was found to be very variable in plants analysed, necessarily resulting from different species, and stages of preparation. The Paraguay and Missione plants contained the most, and the Paranagua and Argentine the least. Senor Arata made a careful research for the caffeic acid and the caffeates that some say they have found in maté, but hitherto with negative results; the same remark applies to a volatile acid.

The tannin of maté is peculiar, it does not tan hides, and requires a special method for its extraction; the average amount obtained by the ordinary method is not more than 12 per cent.; but the whole quantity present amounts to about 16 per cent. Comparing maté with the other caffeic substances, it ranks between coffee and tea for the proportion of caffeine it contains, and has the largest proportion of mineral salts.

The action of maté, like that of all other caffeic substances, is upon the nervous system; but though it contains a large quantity of caffeine it does not exalt the peripheric nerves like tea, nor the cerebriic like coffee, but rather contributes in a high degree to the indolence and drowsiness of the ordinary drinkers of maté, whose mental faculties become at length disarranged and impoverished to a lamentable degree. At least this opinion is enunciated by Dr. Biale in the *Revista Farmaceutica* of the Argentine Pharmaceutical Society. It accelerates (he further adds) the cardiac contractions, producing many more affections of the heart than tea or coffee. Upon the digestive organs it acts variously; no other beverage disturbs them so much, though there are persons who can tolerate its use. It accelerates the peristaltic movements, and produces an irritation of the organs generally. The effects are produced in whatever way the maté may be taken, but the most injurious effects are produced upon the mucous membrane when the maté is taken hot and is sucked through a "bombilla," as it then passes into the mouth uncooled by previous contact with the mouth. When the use of maté is prolonged it becomes an im-

perious necessity, such a gloominess following abstinence from it, that habitual drinkers will rather go without food than without maté. The moderate use of two or three doses a day during the summer heats or great fatigue is convenient, but it should be taken in a cup, for the indiscriminate use of the same bombilla by different persons may become the vehicle of contagion for the most repulsive complaints.

Of the various analyses of the maté that have appeared in books, not one up to the present time deserves much credit.

The value of the exports of maté from Brazil in 1881 and 1882 averaged £304,000.

Paraguay exported in 1882 maté to the value of £200,000. There the annual production is estimated at $5\frac{1}{2}$ million pounds.

EXPORTS OF MATÉ FROM BRAZIL.

Kilogrammes.				Kilogrammes.			
1839-40	..	..	2,549,303	1880-81	..	..	14,275,036
1879-80	..	..	14,063,731	1881-82	..	..	15,952,872

In 1856 it was estimated that 6000 persons were employed in preparing maté in the Brazilian missions. It is for the most part sent by carts to Itaguy, a small town on the banks of the Uruguay, and from there goes by water to the River Plate. In the year ending June, 1858, 2,650,000 lbs. were shipped from that port. At Montevideo the Brazilian maté is preferred to that from Paraguay. About 100,000 cwts. are produced annually in Parana, where it is indigenous; the finer kind is exported to La Plata, the coarser goes to Chili. In 1854 there was imported into Chili 144,792 arrobas.

The shipments from three ports in Brazil in 1863 amounted to 129,028 cwts. In 1865 the total shipments from Brazil to the neighbouring States exceeded 250,000 cwts. Chili is said to take now about 40,000 arrobas of 25 lbs., and Peru 100,000 yearly.

It might be worth while to attempt the introduction and acclimatization of so useful and ornamental a tree in some of our British colonies, such as Queensland and Natal, where the climate is somewhat similar to Paraguay. Looking at the use of its leaves, we see no reason why it should not be cultivated with remunerative profits.

Such a valuable plant, doubtless, is worth the attention of some colonial planters, and with a careful collection of leaves only, and a better method of drying them, the tea would be rendered both grateful and palatable. But we have been so much accustomed to tea leaves being curled up and not powdered to dust, that possibly some prejudice might exist against using it in the form of powder, although the infusion is thereby very readily made.

SUGAR.

The luxuries of man soon become his necessities, and he works with intense thought and labour for things of which he once was wholly ignorant. This is the case with sugar. No longer than five hundred years ago our European race did not know sugar at all. A hundred years ago it was a great luxury. Now it is sold at $2\frac{1}{2}d.$ per pound, and used in abundance as an every-day article by the poorest people. The sugar of commerce is an artificial article, like our distilled liquors, yet the saccharine principle, a distinctive element of food, is found in almost all the plants we use, especially the most valuable. It is met with in the stalk of the maize, and molasses has been repeatedly made from Indian corn. The beetroot contains it in large quantity, and most of the sugar now used in France and in Europe is made from the beet, its culture having been forced by the Emperor Napoleon by means of high import duties. Several other vegetables contain the saccharine principle, which is thus diffused through the vegetable world as an essential element of human food. When we treat it, therefore, as a *necessity* of life, we are not far wrong; for, in one form or another, we must consume it. The fruits contain it, and many trees, as the maple, hickory, and the palms. We are thus invited to use the saccharine element with all our food, and as the concentrated form is the most convenient and manageable, we make it artificially.

The term sugar is a general one, applied to several compounds of carbon, hydrogen, and oxygen (carbo-hydrates), all of which possess a sweet flavour. Of the various sugars, only four are of importance, namely, cane sugar (sucrose), grape sugar (glucose, or starch sugar), fruit sugar (fructose, inverted, or uncrystallizable sugar), and milk sugar (lactose, or lactine). Cane sugar occurs abundantly in the sugar cane, the sugar grass (*Sorghum saccharatum*), several varieties of the maple, in beetroots, mangels, carrots, turnips, pumpkins, chestnuts, and many other plants. Grape sugar is found in fruits, especially when they have been dried and kept for some time; and this sugar is produced from starch by the action of sulphuric acid, and during the germination of seeds. Fruit sugar, or fructose, is found in a great variety of fruits, and cane sugar is converted into this substance by prolonged boiling. Treacle consists of a mixture of 50 parts non-crystallizable sugar and a little grape sugar, 25 parts water, and 25 parts of saline matter. The quantity of starch sugar manufactured for sale is trifling (36,400 cwts.), but enormous amounts of this saccharine substance are incidentally produced in the manufacture of malt liquors and alcohol. Cane sugar, as a commercial product, is at present obtained from only three sources, namely, the sugar cane, the beet, and the maple. Sugars may be divided into two categories:—

1. Pure crystallized cane sugar.
2. Impure sugars. The latter generally consist of a small

quantity of inverted sugar or glucose. Certain salts generally described in analyses as ash, and in the case of very inferior sugars other organic matter, which may be generically described as dirt.

This explanation will enable the reader to understand the following typical analyses, made by Mr. G. E. Halse, chemist, of Mark Lane:—

White crystallized and loaf:—										Per cent.
Cane sugar	..	..	..	..	..	..	..	..	..	98·00
Glucose	..	..	..	..	..	..	..	..	..	·50
Water	..	..	..	..	..	..	..	..	..	1·00
Ash	..	..	..	..	..	..	..	..	..	·30
Organic matter other than sugar	..	..	..	..	..	..	..	..	..	·20
										100·00

Fine pale yellow crystallized:—										Per cent.	Per cent.
Cane sugar	..	..	..	..	..	..	..	..	..	96·00	to 98·00
Glucose	..	..	..	..	..	..	..	..	..	1·00	„ ·50
Water	..	..	..	..	..	..	..	..	..	1·50	„ 1·00
Ash	..	..	..	..	..	..	..	..	..	1·00	„ ·30
Organic matter other than sugar	..	..	..	..	..	..	..	..	..	·50	„ ·20
										100·00	100·00

Low to good yellow crystallized and grey refining crystals:—										Per cent.	Per cent.
Cane sugar	..	..	..	..	..	..	..	..	..	93·50	to 96·00
Glucose	..	..	..	..	..	..	..	..	..	2·50	„ 1·40
Water	..	..	..	..	..	..	..	..	..	2·00	„ 1·20
Ash	..	..	..	..	..	..	..	..	..	1·50	„ 1·00
Organic matter other than sugar	..	..	..	..	..	..	..	..	..	·50	„ ·40
										100·00	100·00

Muscovado, Dutch Nos. 9 to 14:—										Per cent.	Per cent.
Cane sugar	..	..	..	..	..	..	..	..	..	84·00	to 93·00
Glucose	..	..	..	..	..	..	..	..	..	6·00	„ 3·00
Water	..	..	..	..	..	..	..	..	..	5·50	„ 2·00
Ash	..	..	..	..	..	..	..	..	..	1·50	„ 1·00
Organic matter other than sugar	..	..	..	..	..	..	..	..	..	3·00	„ 1·00
										100·00	100·00

Though the manufacture of sugar was commenced in the West Indies early in the sixteenth century, yet its use in domestic economy did not become general in Europe or America before the beginning of the last century. In the year 1700 only 10,000 tons were used in Great Britain, though the English were at that time the leading manufacturers of sugar. The consumption of sugar in the British Islands in the year 1875 was 900,000 tons, and in 1888 1,287,000 tons, supposing all imported taken for consumption. In almost every country the consumption of sugar is increasing.

Production.—The production of sugar now exceeds 6,000,000 tons, of which 2,500,000 tons are obtained from beet, 2,600,000 tons from the cane, and the other 900,000 tons from the palms, maple

tree, sorghum, &c. The United States and the United Kingdom are the principal consumers, taking each in round numbers 1,000,000 tons. Of late years in North America the proportion of sugar consumed exceeds 1,250,000 tons.

THE WORLD'S SUGAR PRODUCTION.

	1885-86.	1884-85.	1883-84.	1875-76.
I. CANE SUGAR.				
	Tons.	Tons.	Tons.	Tons.
Cuba	600,000	627,000	555,000	661,058
Porto Rico	40,000	60,000	60,000	72,128
Trinidad	50,000	65,000	58,000	57,947
Barbados	55,000	60,000	58,000	58,511
Jamaica	20,000	18,000	20,000	23,670
Antigua, Nevis and St. Kitts ..	18,000	16,000	23,000	22,700
Martinique	48,000	42,000	50,000	50,526
Guadeloupe	52,000	41,000	56,000	48,032
Demerara	105,000	90,000	126,000	84,544
Réunion	37,000	36,000	38,000	32,176
Mauritius	105,000	128,000	120,000	87,448
Java	320,000	380,000	311,000	206,612
East Indies (export)	60,000	45,000	60,000	27,963
Brazil	190,000	220,000	290,000	102,509
Manila	215,000	190,000	122,000	126,198
Louisiana	110,000	94,000	128,000	64,277
Peru	40,000	30,000	25,000	60,000
Egypt	30,000	30,000	30,000	40,118
Total	2,095,000	2,172,000	2,130,000	1,826,417
II. BEET SUGAR.				
Germany	800,000	1,155,000	986,000	358,048
Austria	342,000	558,000	446,000	209,000
France	290,000	308,000	474,000	462,263
Russia	525,000	386,000	308,000	222,000
Belgium	50,000	88,000	107,000	70,000
Holland and other countries ..	37,000	50,000	40,000	20,000
Total	2,044,000	2,545,000	2,361,000	1,841,311
Add to this Cane sugar ..	2,095,000	2,172,000	2,130,000	1,826,417
Total	4,139,000	4,717,000	4,491,000	3,167,728

The following may be taken as a rough estimate of the production of sugar over the globe in 1876 and 1886:—

	1876.	1886.
	Tons.	Tons.
Cane sugar	2,140,000	2,635,000
Beetroot sugar	1,320,000	2,546,000
Palm	150,000	200,000
Maple	20,000	23,000
Sorghum	20,000	25,000

PRODUCTION OF CANE AND BEET SUGAR in 1885 and 1886.

(From the Circulars of Messrs. C. RUEB & Co., and Mr. F. C. LICHT).

Countries, cane sugar.	1886.	1885.
	Tons.	Tons.
*Java	328,577	396,372
Surinam	6,283	5,430
Cuba	731,723	631,967
*Manila	181,148	203,490
*Porto Rico	63,914	88,959
Brazil	249,821	190,000
*Mauritius	114,198	127,540
*India	59,253	54,349
Natal	13,250	11,456
Jamaica	25,000	25,361
Barbados	40,780	56,200
Trinidad	49,175	64,634
*British Guiana	111,856	96,058
Australia	87,000	81,245
Louisiana	127,958	94,375
*Martinique	30,199	38,786
*Guadaloupe	36,678	41,131
*Réunion	34,732	37,973
Egypt	51,700	45,035
Peru	35,000	31,719
Sandwich Islands	92,050	76,496
Hayti	12,269	15,484
St. Domingo	2,916	2,221
Nossi Bé	585	412
St. Lucia	4,240	6,252
St. Vincent	6,544	7,425
Grenada	78	612
Tobago	1,678	2,636
St. Kitts and Nevis	14,676	14,619
Antigua	13,114	13,455
Montserrat	1,448	1,150
Argentine Republic	28,000	25,280
*China	86,586	93,657
St. Croix	11,130	12,257
Guatemala	10,000	9,200
Honduras	2,051	1,708
Mexico	34,500	27,025
Dominica	2,740	2,652
Total tons of Cane	2,702,850	2,634,621
Germany	838,131	1,154,817
Austria	377,032	557,766
France	298,407	308,410
Russia	537,860	386,433
Belgium	48,421	88,463
Holland and other countries	37,500	50,000
Total tons of Beet	2,137,351	2,545,889
Grand total	4,840,201	5,180,510

* Exportation only.

As shipments are in most cases the only data to be obtained, it must be recollected that the figures given are far from representing the total production. This is especially the case with such countries as China, India, Central America, Brazil, Peru, and Egypt.

Besides the quantity imported into the markets of the civilised world, as much more, it is estimated, is probably consumed locally in the producing countries. In India the local consumption has been roughly estimated at over 1,000,000 tons.

Consumption.—The following are the latest statistics of consumption of sugar and molasses in the various countries, deduced for the most part from official documents, and the balance of imports over exports. In the European beetroot sugar-producing States it is not always possible to arrive at correct data of the actual consumption, and those countries with a star (*) prefixed are mere rough estimates, being for the most part producing countries for which there are no reliable returns of consumption.

Countries.	Year.	Aggregate Consumption.
Europe—		Cwts.
United Kingdom	1887	17,432,034
Holland	1886	232,860
*Belgium	1886	305,440
*German Empire	1886	4,794,170
Denmark	1885	400,000
Sweden	1885	999,055
Norway	1886	334,143
*France	1886	11,744,154
Switzerland	1886	714,118
Portugal	1886	483,020
*Spain	1886	1,130,800
Turkey	1886	500,000
Greece	1886	87,000
Italy	1886	1,095,835
*Egypt	1886	1,000,000
Roumania	1886	156,860
America—		
*United States	1886	22,549,480
*British America	1886	1,357,100
Brazil	1888	700,000
*Peru	Do.	570,000
River Plate States	Do.	1,000,000
*Other American States	Do.	500,000
West Indian Islands (British and Foreign)	Do.	1,000,000
Australia	Do.	2,000,000
*India, China, the Eastern and Pacific Islands	Do.	25,000,000
Japan (imports)	1885	1,300,000

The differences of consumption shown in this table are startling, but they are owing not only to variations in the wealth of the countries named, but to those of their climate. Countries in which wine is made and fruit ripens, consume less sugar than those situate under more inclement skies. Thus, Austria and Switzerland,

though richer than Sweden and Denmark, consume less sugar than the latter, where no wine is made.

The consumption of sugar has been greatly on the increase in the United Kingdom. Of the total imports less comes, however, from our own possessions than formerly.

	1875.	1887.
	Cwts.	Cwts.
South Africa	29,376	—
Mauritius	585,395	104,986
British India	430,772	853,663
Straits Settlements	116,664	—
British West India Islands ..	3,532,426	} 2,148,245
British Guiana	1,210,193	
British Honduras	34,615	—
Total	5,939,641	3,106,894

The following figures, giving the official consumption per head of the British population at decennial periods, show that we are nearly the largest consumers of sugar of any nation on the globe :—

Year.	Raw Sugar.	Refined.	Total.
	Lbs.	Lbs.	Lbs.
1855	29·22	..	29·22
1865	37·05	2·73	39·78
1875	53·97	8·88	62·85
1885	58·53	15·75	74·30
1887	54·00	21·00	75·00

Of late years, owing to the bounty given by the French, we have been receiving large quantities of beetroot sugar yearly; thus, in 1875 102,300 tons were imported from Germany, France, and Belgium, and in 1887, 767,356 tons. Good cane-sugar has been driven out of the market by inferior beetroot sugar, which for household purposes is 30 per cent. inferior, as every housewife may know by filling two large cups of tea and putting in each precisely the same weight of cane and beet sugar, and tasting the saccharine difference. Now that the bounty has been abolished this is likely to be altered.

Until within a few years ago British Guiana was the only English colony besides Mauritius in which vacuum-pan sugar was made, suited to the wants of the British grocers, but of late Barbados, Jamaica, and some other of the British West India islands have carried out this improvement.

In 1875 we imported 16,264,711 cwts. of raw sugar and 2,860,776 cwts. of refined, besides 768,410 cwts. of molasses and 237,997 cwts. of liquid glucose or starch sugar, and of this quantity only 750,944 cwts. were re-exported. In 1887 there was

imported into the United Kingdom 17,955,229 cwts. of raw sugar, 7,010,762 cwts. of refined, and 305,538 cwts. of molasses.

An estimate of the consumption of sugar made by Charles Bivot, and published in a work at Amsterdam, gave the following proportionate consumption of sugar in different countries for 1882 :

	Tons.	Kilogrammes per head.
Great Britain	900,000	29·35
France	265,000	7·35
Germany	280,000	6·5
Russia	250,000	3·09
Austria Hungary	200,000	5·55
Italy	90,000	3·25
Spain	50,000	3·03
Netherlands	30,000	8·40
Sweden	36,000	8·80
Norway	10,000	5·55
Turkey	25,000	1·08
Belgium	35,000	6·50
Portugal	20,000	3·4
Denmark	12,000	6·15
Switzerland	25,000	9·90
Greece	5,000	3·4
Europe	2,233,000	7·3
United States of America	800,000	16·16

SUGAR CONSUMPTION in the UNITED STATES, ACCORDING to BOUCHEREAU.

	Tons.		Tons.
1876	745,269	1882	1,077,949
1877	745,250	1883	1,164,391
1878	773,472	1884	1,265,383
1879	831,896	1885	1,245,574
1880	922,109	1886	1,388,371
1881	1,008,932		

The largest imports, 48 per cent., are from Cuba. The other supplies come from the Sandwich Islands, which exports 215,000 tons, Philippines, Brazil, India, and Germany.

AVERAGE ANNUAL CONSUMPTION of SUGAR (CANE and BEET) PER HEAD in VARIOUS COUNTRIES.

	Lbs.		Lbs.
New Zealand	118·77	Sweden	17·25
South Australia	102·11	Belgium	15·74
Western Australia	93·51	Germany	15·01
Victoria	90·75	Austria Hungary	13·23
Tasmania	90·49	Norway	11·37
United Kingdom	68·99	Portugal	9·56
Queensland	62·93	Roumania	7·71
New South Wales	60·95	Russia	7·69
Denmark	29·69	Spain	5·11
Holland	28·37	Servia	4·41
Switzerland	22·81	Italy	3·20
France	22·61	Finland	1·32

In Victoria 14,000,000 lbs. of sugar are used annually in the manufacture of beer, which is much more than many countries consume altogether.

RANGE of PRICES of SUGAR per Cwt., in DECENNIAL PERIODS.

Years.	Raw.				Refined.			
	s.	d.	s.	d.	s.	d.	s.	d.
1787	50	0	to	78	0	54	0	to 121 4
1797	68	0	„	114	0	78	0	„ 186 8
1807	56	0	„	100	0	54	0	„ 186 8
1817	81	0	„	100	0	75	0	„ 185 0
1827	64	0	„	80	0	57	0	„ 160 0
1837	54	0	„	70	0	43	0	„ 110 0
1847	33	0	„	56	0	33	0	„ 175 0
1857	41	0	„	61	0	40	0	„ 70 0
1867	25	0	„	41	0	27	6	„ 53 0
1877	15	6	„	36	0	20	6	„ 38 0
1887	9	9	„	17	6	10	6	„ 19 9

Molasses.—Besides sugar we receive much syrup or molasses, The largest quantity now comes from the United States. The following were the countries which furnished us supplies in 1875 and 1886:

—		1875.	1886.
		Cwts.	Cwts.
Russia	..	..	3,820
France	..	103,089	..
Egypt	..	36,762	..
United States of America ..	..	366,916	375,750
Spanish West India Islands ..	..	75,569	..
Australasia	..	55,549	7,574
British West India Islands ..	..	113,187	33,095
British Guiana	..	2,897	..
Other countries	..	14,444	10,251
Total		768,410	430,490

It is a remarkable fact that the West Indians should export their molasses in such a state that it contains large quantities of extractable crystallizable sugar, and that a large and profitable trade should be carried on in its extraction both here and in the United States. Molasses proper ought to contain no extractable crystallizable sugar, and if it does contain any it ought to be called syrup, and not molasses. By cutting the canes at the wrong period, by keeping them till acids form, by boiling the juice in such a way as to ensure the acidity spreading as far as possible, the planter creates very much more than the unavoidable amount of molasses, worth from half to one-third the price of sugar; and he still further carelessly wastes his resources by letting large quantities of extractable sugar remain in the

molasses. The colonial planter ought to study what is done on the Continent, in order to extract the last possible fraction of sugar from molasses. For instance, his attention should be directed to applying to the cane some modification of the supersaturation process of M. Marguerite, or of the osmogene process of M. Dubrunfaut, both of which processes are founded on strictly scientific principles.

Rum, another product from the sugar-cane, which we require largely for the supply of our navy, is furnished almost entirely from our own colonies. The imports from these in 1875 and 1886 having been, from

	1875.	1886.
	Galls.	Galls.
Mauritius	583,365	116,976
British West India Islands ..	3,445,566	1,600,168
British Guiana	3,624,294	2,850,925
Other Colonies.. .. .	..	247,550
Total	7,653,225	4,815,619

VARIETIES OF THE SUGAR CANE.

The sugar-cane (*Saccharum officinarum*, Lin.) has a jointed stem from 6 to 12 feet high or more, solid, hard, dense, internally juicy, and hollow only in the flowering tops.

It succeeds in almost all tropical and sub-tropical countries, reaching in South America and Mexico an elevation above the level of the sea of about 5000 to 6000 feet. It is cultivated in most parts of India and China, up to 30° to 31° N. lat., the mountainous regions excepted.

In the United States the profitable culture of the cane ceases at 32° N. lat.; in Japan it is carried on with advantage to 36° N. lat. and even further northward. The average yield of rawsugar even there is 3300 lbs. per acre. There is a particular kind in China (*S. sinense*, Roxb.) which is hardier, and bears the drought better than the ordinary cane; this kind needs renewal only every third year, and ripens in seven months if planted early in spring, but if planted in autumn and left standing for fully a year the return of sugar is larger.

In most of the torrid parts of the New World and in many of the islands of the West Indian group, species of the genus *Saccharum* have been found in an indigenous state. In the cultivated parts of Trinidad three species were met with: *S. contractum* Poit.; *S. polystachyum*, Sw.; and *S. dubium*, H. B. The variety denominated the ribbon-cane, from its variegated coloured stripes, is also indigenous to that island, and to the neighbouring continent. This cane is remarkably hardy, but is less productive than the Otaheite cane now generally cultivated, and which was taken to

the West Indies in 1769. The purple cane, a native of the American continent, has been grown in the islands, but is found inferior to the Otaheite cane.

The sugar-cane is found spontaneous in India, Cochin China, and the South Sea Islands. A very saccharine but hard cane is wild in New Guinea.

In an account of the Society Islands and their principal vegetable products, by M. Cuzent, some interesting details are given of the varieties of sugar-cane cultivated there.

Eight species are enumerated.

1. *Saccharum atrovibens*, called locally To Uti. The stalk is of a fine violet colour, large, and contains much juice, the pith is also of a violet hue. This variety is cut at about fourteen months. It is not indigenous, but was imported from Batavia in 1782 by Bougainville and Blight, who also introduced into the various colonies the varieties of canes with green and yellow stems known in the Antilles under the name of Tahiti canes.

2. *S. rubicundum*. Native name Rutu or Rurutu. The stem is of a clear violet, with white pith; the young leaves are violet coloured. This cane comes from Cook's Archipelago, and takes its native name from the island of Rurutu.

3. *S. fragile*. Native name Irimotu. This has a green stem, which is fragile and breaks with a straight fracture without splintering; the pith is white. It is rich in juice, but is little cultivated, because its stem is so pubescent, and the hairs enter the skin in cutting the cane, and also attack the respiratory organs.

4. *S. rubicundum* variety. Native name Oura. This is the ribbon-cane, having a violet stem with longitudinal bands of a bright yellow; the pith is white. This grows to a great size, especially in humid soils.

5. *S. obscurum*, Trin. Native name Piavere. This is the Creole cane; it has a light red stem, and does not grow so large as the preceding varieties, the internodes are also less distant. The pith is white, and the juice not being so rich it is regarded as an inferior species.

6. *S. glaber*. Native name Vaihi-uouo, or simply Uouo, white, from the colour of its stalk. It does not contain so much juice as the other species, but its sap is more rich in crystallizable sugar. It was introduced from the Sandwich Islands, whence the name Vaihi, which is given to those islands by the Tahitians.

7. *S. fragile* variety. Native name Avae. This has a yellow stalk banded with clear green, having some resemblance to No. 6 Vaihi. The pith is white, tender, and very juicy, hence the natives chew it in preference to the other kinds, but the sap is not very rich in crystallizable sugar.

8. *S. fatuum*, Bechey.

There are also two other indigenous varieties met with on the flanks of some of the mountains, which are not large, and designated by the natives under the generic name of To-Aeho. The first, called To-Patu, is red, and contains more juice than the second, the

stalk of which is white. These varieties belong to the species known as *S. spontaneum*, Lin., or *S. floridulum*, Labill.

The Tahiti canes yield a fourth more juice and a sixth more crystallizable sugar than most of the other canes grown in the colonies. The botanical names given above are on the authority of M. Pancher, botanist at New Caledonia.

The Salangore cane, an eastern variety, has been introduced into Brazil and the French West Indian colonies; in the former it has become diseased, but in the latter it is well spoken of.

The Salangore cane is spoken favourably of in Jamaica; it grows with great vigour under irrigation, and the number of shoots springing from each cane is remarkable. This variety should be planted wider apart than the space allotted to other kinds of cane.

The time has come when the yield of the cane must be increased, and it is well known that certain species are more susceptible of improvement than others. This law runs throughout the vegetable kingdom, and people who cultivate vegetables for manufacturing purposes always therefore not only seek for what grows best, but for what will yield most readily to cultivation. The beetroot-growers, by acting according to good judgment on this point, have devoted so much attention to the selection of the richest varieties of their plant, that they have raised its saccharine strength from barely 4 per cent. to 8 and even 12 and 15 per cent., and this within less than fifty years. On the other hand, it is undeniable that the cane-growers have remained content with the gifts of nature, and have done very little towards raising the quality and productiveness of their plant. The humble root which rivals the cane has been doubled and trebled in richness, whilst the sugar-cane has remained comparatively stationary.

The results obtained from the trial of the Salangore cane at a plantation called Grand Parc, situated near Basseterre, are specially noteworthy. Planted at the full distance apart (two yards by two yards), which is an essential condition, and manured at the right times, the Salangore cane grows with such vigour, and in such thick tufts, that in five or six months it forms so thick a green covering that weeds cease to grow about it. The weedings are thus notably reduced. The cane goes through the period of flowering without injury. The tufts yield from twenty-five to forty canes. In consequence of the enormous quantity of canes produced by each tuft, the weight to the acre is much above that of an ordinary acre of canes. In one case sixteen tufts of canes, which were far from being the finest in the field, were cut in a square space of 38·45 metres, and they weighed 367 kilogrammes net, from which, in proportion, we should find, in round numbers, 100,600 kilogrammes to the hectare. In Guadaloupe, an average of 40,000 kilogrammes of cane to the hectare is obtained, whilst at Grande Parc 30,000 only are obtained. The average at Beauport was only 27,000 kilogrammes to the hectare. The *bagasse* of the Salangore cane gives so much fuel that only a small addition of straw is required, and this quantity leaves as much upon the ground for the use of the plantation as other kinds of canes.

The juice of the Salangore cane is abundant, and the yield per acre is considerably superior to that of other canes.

Experiments in shortness of time to ripen, gallons of liquor per acre, saccharine strength per polariscope, and other particulars are required before the planter can know the relative value of the different kinds. There is not the least reason to doubt that with selection and good nursing very superior and fixed qualities can be obtained in the sugar-cane, as freely as they have been in wheat, turnips, beet, fruit, garden flowers, and domestic stock. Tropical staples are ages behind Europe in this respect, and have hence grand possibilities *in ovo*, but they will not be realised without effort, judgment, and perseverance. According to a Barbados paper, a foot in length of sugar-cane grown in that island weighs three-quarters of a pound, and a bunch of canes grown in one hole weighs 54 lbs. on an average, which yield 4 gallons of liquor or juice, from which 4 lbs. of muscovado sugar are got. Of the 54 lbs., the juice weighs 50 lbs. An acre of ripe canes, planted 6 by 5 feet, gives 1452 bunches, or 5808 gallons of juice, or 5808 lbs. of sugar. At 50 lbs. of cane to the hole (or hill), an acre of canes, planted as above, would weigh, when cut, 72,600 lbs., or 36 tons, 90 per cent. being juice. It takes thus 36 tons of cane to give $2\frac{1}{2}$ tons of raw sugar, or 360 tons from a 10-acre field to yield 25 tons of sugar. For the first six months the plant requires but little rain to keep it in vigour; but afterwards it needs a constant supply, and an increase of growth in the last three months of the year.

The multiplication of all sorts of sugar-cane is usually effected from top cuttings, but this cannot be carried on for an indefinite period from the same original shoots without deterioration; and as seeds hardly ever ripen on cultivated canes, new plants must from time to time be brought from a distance.

Excessive rains produce a rank luxuriance of the canes at the expense of the saccharine principle. Rich manuring is necessary to attain good crops, unless in the best virgin soil. The lower leaves of the stem must be successively removed (a process called "trashing"), also superabundant suckers, to promote the growth upwards and to provide ventilation and light. Moderate vicinity to the sea is favourable to the growth of the cane. The average yield of sugar varies from $1\frac{1}{4}$ ton to 3 tons per acre.

The following description of varieties of cane has been published by Messrs. Ohlendorf:—

The Otaheite or Bourbon cane is probably the kind of cane planted over the largest area. Whether the so-called Otaheite and the Bourbon cane are two distinct varieties, or have the same origin, seems to be doubtful. The Bourbon cane is certainly not indigenous in the island of Bourbon (Réunion), but came originally from the coast of Malabar. It was transferred to the West Indies from Bourbon, and has spread over most colonies.

There are two Otaheite canes, the yellow or straw-coloured, and the purple-striped or ribbon.

With a good soil and favourable season plants of the first year's growth often attain the height of 12 to 14 feet, measuring 6 inches

in circumference, with joints 8 or 9 inches apart. They attain maturity in ten to twelve months; but on very rich land or in wet seasons it may be expedient to allow them even fourteen months.

The purple-striped Otaheite cane is very much like the ribbon-cane of Batavia in appearance, but the former has broad purple stripes on a greenish yellow ground, whereas the latter is of a blood-red on a transparent, straw-coloured ground. It is a hardy and esteemed description, of large size, soft, juicy, and sweet, and yields sugar in uniform quantities, though of a rather dark colour.

Batavian canes are of four descriptions, viz., the yellow violet, the purple violet, or Java cane; the transparent or ribbon cane, and the Tibboo Batavee, or Batavian cane.

The yellow violet differs from the Bourbon in being smaller, less juicy, considerably harder, of slower growth, of much darker foliage, and more erect. When ripe it is usually of straw colour; its skin or rind is thick, and the pith is hard, but its juice is rich and abundant. The yellow violet contents itself with a soil of inferior quality.

The purple violet, or large black cane of Java, is fully as thick as the Otaheite, with joints varying from 3 to 7 inches apart. In height it is usually about 8 or 10 feet, with leaves of a brighter green than the yellow violet.

Very frequently a white resinous film is seen encrusted on the joints of this cane, sometimes lying so thick that the purple of the cane itself is in some joints almost hidden.

When in perfection it yields a very sweet and rich juice. It is very hardy, thriving well in poor, dry soils. In Jamaica it is often planted in the outer rows of the cane fields, to stand the brunt of trespassing cattle.

The Malays term it Tibboo Etam, or black cane.

The transparent, or ribbon cane, is much smaller than the Otaheite ribbon cane. It is of a bright transparent yellow, with a number of blood-red streaks or stripes running the whole length of the stalk, and varying in breadth from $\frac{1}{4}$ to 1 inch. It grows from 6 to 10 feet high, with joints from 4 to 8 inches apart, and 4 inches in circumference. It is generally planted in light sandy soils where no other cane will thrive. Although its rind is thick and its general texture hard, yet it yields a good quantity of juice of excellent quality, which is easily converted into fine white sugar.

The Tibboo Batavee is common in the Straits of Malacca, where it is cultivated by the Malays. In appearance it is much like the yellow violet, except in the peculiarity of its colour, which is rather greenish, with a pink shade in parts; in some of the lower joints this pink colour is very bright and pretty, whilst in the upper joints it is more faint and delicate.

East Indian Canes.—The large red canes of Assam are very juicy and sweet; the sugar produced from them is of an exceedingly fine grain and good colour; they are strong in growth and fully

equal in size, as well as in quantity and quality in juice, to the Otaheite. The red cane of Bengal (Tibboo Merah) is a large and fine cane much used about Calcutta for sugar manufacture.

The next large canes are the black and the yellow Nepal, large-sized and firm-looking canes, fully equal in appearance to the Assam.

As to the small-sized canes cultivated in India, they are very numerous, the most common being the Kajlee and the Pooree. They are inferior to the colonial kinds.

The Chinese sugar-cane possesses the advantage of being so hard and solid as to resist the forceps of the white ant and the teeth of the jackal—two great enemies to the East Indian sugar plantations. It is difficult to express the juice with the Bengal native sugar mill; but the cane bears drought much better than the sorts in general cultivation, producing a profitable crop even to the third year. It is extremely hard and prolific; during very hot seasons it remains uninjured in every respect, whilst other canes are all either burnt up or eaten out of the ground by the white ant.

As the rains come on the China cane springs up wonderfully, many roots having no less than thirty shoots, which by September become fine canes about 12 feet in height, 3 inches in circumference, with joints 6 to 8 inches apart.

The elephant cane, of Cochin China, has been stated to reach a height of 11 feet and a diameter of 7 inches in six months. This variety is only cultivated for eating or chewing, and might prove to be a good sugar-producing cane. But as varieties, especially in the case of sugar-canes, often improve by change of climate and soil, perhaps this might succeed better elsewhere.

The Straits Settlements grow eight kinds of sugar-cane, foremost among which is the Salangore, called by the Malays Tibboo Capper or Tibboo Bittong Beraboo. This is one of the finest canes known, attaining a weight of 25 lbs., a height of over 13 feet, and a diameter of 3 inches under favourable conditions.

It ratoons better than any other kinds in the Straits. As plant canes they have given an average of 6500 lbs. of granulated sugar to the acre, sometimes increasing to 7200 lbs.

The Salangore cane grows firm and strong, remaining much more erect than the Otaheite; it affords an abundance of juice, which is sweet, easy of clarification, boils well, and produces a very fine fair sugar of bold and sparkling grain.

The varieties known in the South Pacific Islands are very numerous, and some of them are accredited with marvellous results. One variety grown on the Sandwich Islands, on 30 acres of good land under irrigation, is said to have given an average yield per acre of 12,000 lbs. (6 hhds.) of No. 16 sugar.

A great number of varieties of cane have been brought over from Mauritius and the East to the West Indies, and recently three new varieties have been made known, called the Caledonian Queen, green Salangore, and a violet Salangore.

It is well known that the old varieties grown for many years

deteriorate, and it would therefore seem to be imperative for the sugar planter to look for other varieties giving better yields.

The canes from the South Pacific Islands seem to deserve attention in this respect as well as some from the East.

Mr. Preston of Trinidad thus speaks of these varieties :—

The Caledonian Queen is a pale or greenish purple cane, close-jointed, and extremely vigorous. The leaves are remarkably broad, and their bases are nearly destitute of the setae, or "cowitch," common to most canes. This cane is said to attain enormous dimensions in the East, and to be one of the most sacchariferous. The short joint is a feature which is generally considered objectionable, accompanied as it usually is by great hardness of cane tissue. In this respect, however, the Caledonian Queen cane is an exception, and the ready way in which both length of joint and diameter of cane is affected by manure, indicates great variability of habit, and suggests gigantic growth under the influence of rich alluvial.

The green Salangore is so named from its retaining a green colour on the cane much longer than usual, although when fully ripe the colour of the cane is yellow, but not so bright a yellow as that of a well-ripened Otaheite. This variety is the freest-growing of all the varieties grown, except the giant Claret cane, and its erect habit is even more striking than in that variety. Both in respect of length of joint and diameter, it is equal to it, thus being the largest yellow cane grown here. The foliage is large and heavy, but completely deciduous, so that the operation of "trashing" is with it reduced to a minimum. The most striking feature in this cane, besides its size, is the broad white rim just below each joint.

The violet Salangore has the habit of erect growth more strongly developed than is seen in any other of the canes enumerated, as it is distinctly the longest jointed and tallest, with a full average diameter of cane. The leaves are long and narrow as compared with the well-known Otaheite.

The remarkably erect habit of growth in these two Salangores is a character which, considering the influences most conducive to a highly saccharine juice and a large yield of sugar per acre, is of importance, and on this account it is deemed desirable that they should be brought into notice, if only for experiment.

One of the most commonly observed facts on a sugar estate is that canes grown erect, and therefore enjoying full sunlight and air, are yellow and full of sugar, whereas canes lying on or near the ground, and thus deprived of light and air by their erect companions, are green and deficient in sugar. The erect or decumbent postures of the cane are in a measure dependent on soil, and the kind of culture they are treated to, especially when young, but under any circumstances a marked disposition to maintain an erect habit of growth is an obvious advantage in respect of the sugar yield.

It is generally admitted that a yield of 3 hogsheads per acre is

a maximum yield, and of rare attainment; a larger yield is scarcely thought of, even as a possibility, yet it is a fact that a yield of $2\frac{1}{2}$ or 3 hogsheads is attained from fields in which a very large portion of the canes are trailing, that is to say, green and deficient in sugar. The question naturally arises as to what the yield would be if all such canes (being erect and therefore rich in sugar) were up to a high level yield. In this view it is not difficult to imagine a yield of $4\frac{1}{2}$ or 5 hogsheads per acre.

Jamaica.—Much attention has been devoted to the care and culture in Jamaica of new varieties of cane, of which sixty have been reared and distributed. Forty-two of these were introduced from Mauritius in 1882, the remainder from the Southern States of America, while special canes such as the Elephant cane and the Salangore cane, were either received from the Royal Gardens at Kew, or from the Botanical Gardens, Martinique. Of the ordinary Jamaica canes, which have been under general cultivation in that island for many years, there are kept for comparison with the new canes, the following, viz., the Otaheite, the Bourbon, the Transparent, the Violet, the White Transparent, and the Common Transparent.

Mr. D. Morris, now Assistant Director at Kew, when in the island filling the office of Colonial botanist, reported thus on the new varieties introduced :—

With the view of placing in a succinct form the relative merits of the new varieties of sugar-canes, I have during the past year prepared a description of each variety as they appeared to me in the field, to which, by the kind assistance of Mr. A. J. Pine, the intelligent Manager of Mona Estate, I have been able to add the percentage of juice and trash, the density of the juice, and other information calculated to be of value to the planter. It should, however, be mentioned that the measurements and yield here given of the several canes, are not to be taken as their ultimate standard; but rather what they have so far attained under the conditions which obtain at the Hope. The land on which they are grown is rather poor in nitrogenous compounds, of a dry gravelly texture, and what planters would term "old cane soil," pretty well worn out.

There is no doubt that soil and climate greatly affect the quality of the juice, and also the quantity and quality of the sugar produced by the plant. This is shown by the fact that a variety of cane, strong, healthy, and yielding profitable returns in one district, when removed to another only a few miles away, has been known to lose many of its good qualities.

A descriptive summary of the new canes is as follows :—

1. *Tourkoury.*—Of stout habit; 10 to 14 canes in a clump; about 8 feet high; length of joints 4 inches, circumference 4 inches; colour white; leaves light green, 4 feet 6 inches long, $1\frac{1}{2}$ inches broad; healthy cane evidently suitable for moist districts; does not stand drought well. Percentage of trash $25\frac{1}{2}$; juice $74\frac{1}{2}$ (6.9 gals.); density of juice 1.064: Arnaboldi 21.

2. *Cuapà*.—Of slender habit; 18 canes in a clump; average height 9 feet; colour black; length of joint 4 inches, circumference 4 inches; leaves heavy, 4 feet long, $2\frac{1}{2}$ inches broad; stands drought well; not liable to get lodged; free from rust. Percentage of trash $31\frac{1}{2}$; juice $68\frac{1}{2}$ (6.3 gals.); density of juice 1.066: Arnaboldi 22.

4. *Batramic*.—Of strong habit; 12 to 14 canes in a clump; average height 7 feet; colour striped; length of joints 4 inches, circumference 4 inches; leaves heavy, $4\frac{1}{4}$ feet long, 3 inches broad; stands the drought well; not liable to get lodged; "a strong cane." Percentage of trash $33\frac{1}{3}$; juice, $66\frac{2}{3}$ (6.2 gals.); density of juice 1.074: Arnaboldi, 24.

5. *Waphendnow*.—Similar to last in habit and colour; a strong cane. Percentage of trash 31; juice 69 (6.4 gals.); density of juice 1.066: Arnaboldi 24.

6. *Tiboo*.—Prolific cane; 12 to 14 canes in a clump; average height 8 feet; colour striped; length of joints 3 and 4 inches, circumference $5\frac{1}{2}$ inches; leaves heavy, broad, and abundant; stands drought well; not liable to get lodged. Percentage of trash $31\frac{1}{4}$; juice $68\frac{3}{4}$ (6.4 gals.); density of juice 1.069: Arnaboldi 24.

7. *Hilli*.—Of slender habit; 16 canes in a clump; height 9 feet; length of joint 5 and 6 inches, circumference $3\frac{1}{2}$ inches; leaves heavy, round stem, 4 feet long, 3 inches wide; stands drought well; stools freely; a prolific small black cane suitable for poor soils. Percentage of trash 35; juice 65 (6.0 gals.); density of juice 1.067: Arnaboldi 22.

8. *Seete*.—Of stout habit; 12 to 16 canes in a clump; height 8 feet; colour a greenish yellow when young, white when matured; length of joint 4 inches, circumference 3 inches; foliage very heavy, length 4 feet, breadth 3 inches; stands drought moderately well; a good cane for experimental trial in good soils. Percentage of trash 30; juice 70 (6.5 gals.); density of juice 1.082: Arnaboldi 28.

9. *Ysaquia*.—Of stout free habit; 15 canes in a clump; height 7 feet; colour brown with white stripes; length of joint 3 inches, circumference 5 inches; foliage rather heavy; stands drought fairly well; somewhat liable to get lodged and with rust on upper joints. Percentage of trash 37; juice 63 (5.8 gals.); density of juice 1.084: Arnaboldi 28.

10. *Bouronappa*.—Of stout vigorous habit; 20 canes in a clump; height 8 to 10 feet; colour light purple; length of joint 3 and 4 inches; circumference $4\frac{1}{2}$ inches; foliage rather heavy; stands drought well: from its luxuriant quick-growing habit liable to lodge, but is one of the finest canes of the series as regards luxuriance of growth; and should prove an acquisition in districts with moderate rainfall. Percentage of trash 40; juice 60 (5.5 gals.); density of juice 1.079: Arnaboldi 26.

11. *Barkley*.—A white cane similar to last; fewer canes in the stool but of stouter habit; foliage heavy; stands drought moderately well; free from rust and of free vigorous growth. Percentage

of trash 34; juice 66 (6.1 gals.); density of juice 1.078: Arnaboldi 26.

12. *Pine*.—Of light habit; 12 canes in a clump; height 9 feet; colour white; length of joint 4 inches, circumference 5 inches; leaves light, 4 feet long, 3 inches broad; stands drought well; stools moderately well. A fair hard cane, very healthy and clean. Percentage of trash 30; juice 70 (6.5 gals.); density of juice 1.078: Arnaboldi 26.

13. *Nagapoury*.—Of strong vigorous habit; 16 canes to a clump; colour cream white; length of joint 4 inches, circumference 5 inches; foliage heavy; does not stand drought but grows well in fairly moist situations; an excellent cane under irrigation. Percentage of trash 31; juice 69 (6.4 gals.); density of juice 1.065; Arnaboldi 21.

14. *Naga*.—Of fine slender habit; 20 and 25 canes to a clump; colour black. length of joint 4 inches, circumference 3 inches; leaves moderately heavy but narrow; stands drought well; evidently an excellent cane for arid districts or as a fodder plant on poor soils. Percentage of trash 35; juice 65 (6.0 gals.); density of juice 1.072: Arnaboldi 24.

15. *Tsimbic*.—Of stout habit; 15 canes to a clump; height 9 feet; colour yellow with purplish stripes; length of joint 5 inches, circumference 5 inches; foliage light and leaves narrow (2 inches); stands drought moderately well. A good striped cane of fine attractive habit. Percentage of trash 33; juice 67 (6.2 gals.); density of juice 1.082: Arnaboldi 27.

16. *Vulu-Vulu*.—Of stout habit; 10 to 12 canes in a clump; height 8 to 10 feet; length of joints 4 inches, colour fine yellow; foliage light; stands drought well; not liable to lodge; free from rust. Percentage of trash 35.75; juice 64.25 (5.9 gals.); density of juice 1.078: Arnaboldi 26.

17. *Kakæ cane*.—Of stout habit; 16 to 18 canes in a clump; height 10 feet; colour black violet; length of joint $3\frac{1}{2}$ inches, circumference 5 inches; foliage very heavy and of a dark green; as in most of the black or violet canes this stands drought well; it is free from rust and not liable to get lodged. Percentage of trash 36; juice 64 (5.9 gals.); density of juice 1.084: Arnaboldi 28.

18. *Egyptian cane*.—Of vigorous habit and quick growth; 30 to 40 canes in a clump; height 7 to 8 feet; colour striped green; length of joint 4 inches, circumference 3 inches; foliage light and narrow; a fine clean healthy cane, very hardy and likely to thrive in dry districts. Percentage of trash 41; juice 59 (5.4 gals.); density of juice 1.077: Arnaboldi 27.

20. *Brisbane*.—Similar to the Malay cane already tested and distributed as No. 76.

21. *Grand Savanne*.—Of strong compact habit with stout joints; 20 canes to a clump; height 10 feet; colour light purple; length of joints $5\frac{1}{2}$ inches, circumference $5\frac{1}{2}$ to 6 inches; foliage dark green and broad; a good cane in appearance but not yet tested.

22. *Bourzow*.—Of light graceful habit; number of canes to a clump 12 to 16; height 8 feet; colour at first green, then a golden

yellow; foliage light and narrow; does not stand drought well but grows rapidly under irrigation; not liable to get lodged. Percentage of trash 37; juice 63 (5.8 gals.); density of juice 1.074: Arnaboldi 24.

23. *Liguanea*.—Of short stunted habit; number of canes in each clump 10 to 12; height 6 to 8 feet; colour dark purple or black; length of joint $3\frac{1}{2}$ inches, circumference 5 inches; foliage light; length $4\frac{1}{2}$ feet, breadth 3 inches; stands drought very well. Percentage of trash $33\frac{1}{2}$; juice $66\frac{2}{3}$ (6.2 gals.); density of juice 1.076; Arnaboldi 25.

24. *Norman*.—Of strong habit and erect; number of canes in each clump 14; height 11 feet; colour light purple or mauve; length of joints 5 inches, circumference $5\frac{1}{2}$ inches; foliage pale green with a light purplish vein running down the centre of each leaf. Percentage of trash 36; juice 64 (5.9 gals.); density of juice 1.082: Arnaboldi 27.

25. *Green Rose-Ribbon*.—Of stout upright habit; number of canes in each clump 18; height 10 feet; colour pale yellow; length of joint 4 and 5 inches, circumference 6 inches; foliage coarse and heavy. This cane stands drought moderately well; is somewhat liable to get lodged and shows rust. Percentage of trash 39; juice 61 (5.6 gals.); density of juice 1.064: Arnaboldi 21.

26. *Daura*.—A weak yellow cane apparently of little value.

27. *Nain*.—Habit strong, with large stools ratooning freely; canes in each clump 35; height 10 feet; colour light brown; length of joint 5 inches, circumference 5 inches; foliage of a fine texture and dark green, leaves short and broad. This cane stands drought well; a clean healthy cane of very vigorous habit. Percentage of trash 34; juice 66 (6.1 gals.); density of juice 1.066: Arnaboldi 23.

28. *Queensland*.—Of upright habit; canes in each clump 30; height 12 feet; colour pale yellow; length of joint 6 inches, circumference 5 inches; foliage large and heavy; grows well in dry situations; liable to get lodged; free from rust. Percentage of trash 37.66; juice 62.34 (5.7 gals.); density of juice 1.068: Arnaboldi 23.

29. *Ko-Keia*.—Slender upright habit; canes in each clump 35; height 8 feet; colour white with red stripes; foliage moderately heavy. A prolific useful cane for fodder purposes. Percentage of trash 38; juice 62 (5.7 gals.); density of juice 1.079: Arnaboldi 26.

30. *Lahina*.—Of rather delicate habit at first but afterwards a strong fine cane; canes in each stool 18; height 9 to 11 feet; colour yellow; length of joint 5 inches, circumference $5\frac{1}{2}$ inches; foliage pale green and moderately light. This cane does not stand drought well and is liable to get lodged. A bright free-growing cane under irrigation, very much like the best type of Bourbon canes. Percentage of trash $37\frac{1}{2}$; juice $62\frac{1}{2}$ (5.8 gals.); density of juice 1.076: Arnaboldi 25 (Beaumé 10).

31. *Keni-Keni*.—Of slender habit; 12 to 15 canes in a clump; 8 to 10 feet high; length of joints 5 inches, circumference 4 inches; colour white; leaves green, 4 feet 6 inches long, $2\frac{1}{2}$ inches

broad; fine healthy cane suitable for "seasonable" districts; does not stand drought well. Percentage of trash 33; juice 67 (6.2 gals.); density of juice 1.080; Arnaboldi 26.

32. *China*.—Very similar in habit, size and characteristics to last. Percentage of trash 35; juice 65 (6.0 gals.); density of juice 1.066: Arnaboldi 22. [Canes Nos. 28, 30, 31 and 32 all partake of general characteristics and belong to the best type of white canes.]

33. *Po-a-ole*.—This would appear to be identical with the Mauritius cane No. 96 already described and tested in 1880. "A stout black cane of fine habit and growth, leaves rather heavy; stands drought well; rind rather hard; not subject to lodge; makes a good grain of sugar and yields at the rate of $2\frac{1}{3}$ hogsheads per acre."

34. *Ko-poapa*.—Of strong rapid growth; 18 canes in a clump; about 11 feet high; length of joints 4 inches, circumference 5 inches; colour white; leaves moderately heavy, 5 feet long, $2\frac{1}{2}$ inches broad; stands drought well; not liable to get lodged; a fine white cane, one of the best in the collection for dry districts; always healthy and throwing good large stools. Percentage of trash 28; juice 72 (6.4 gals.); density of juice 1.063: Arnaboldi 21 (Beaumé 8.2-5).

35. *Lakoua*.—Of upright and somewhat slender habit; about 12 feet high; length of joints 6 inches, circumference 4 inches; colour white; leaves dark green; 5 feet long, 3 inches broad; healthy, vigorous cane and free from rust. Percentage of trash $30\frac{1}{2}$; juice $69\frac{1}{2}$ (6.4 gals.); density of juice 1.074: Arnaboldi 24 (Beaumé 9.4-5).

36. *Vituahuala*.—Strong vigorous habit; 30 canes in a clump; about 11 feet high; length of joints 3 inches, circumference 4 inches; colour pale when young growing into a light purple; leaves dark green, $4\frac{1}{2}$ feet long, 3 inches broad; somewhat liable to lodge; free from rust. Percentage of trash 24; juice 76 (7.0 gals.); density of juice 1.055: Arnaboldi 18 (Beaumé $7\frac{1}{3}$).

37. *Sacuri*.—Of strong habit and very rapid growth; 20 canes in a clump; average height 11 feet; length of joints 6 inches, circumference 5 inches; leaves somewhat heavy, 5 feet long, 3 inches broad; likely to lodge; free from rust. Percentage of trash 25; juice 75 (7.9 gals.); density of juice 1.076: Arnaboldi 25 (Beaumé 10).

38. *Cuban*.—Habit light; 12 canes in each clump; height 10 feet; joints long and straight; leaves light green, 5 feet long, $2\frac{1}{2}$ inches broad; suitable for moist districts only; a clean healthy cane resembling the Bourbon. Percentage of trash $33\frac{1}{3}$; juice $66\frac{2}{3}$ (6.2 gals.); density of juice 1.074: Arnaboldi 24 (Beaumé 9.4-5).

39. *Horne*.—Habit strong; 20 to 25 canes in each clump; height 10 feet; colour pale, with purple and violet stripes; length of joint $4\frac{1}{2}$ inches, circumference 5 inches; leaves heavy, 5 feet long, 3 inches broad; stands drought well, and not liable to get lodged. Percentage of trash $24\frac{1}{4}$; juice $65\frac{3}{4}$ (6.1 gals.); density of juice 1.076: Arnaboldi 25 (Beaumé 10).

40. *Samuri*.—Of slender habit; 16 canes in each clump; average height 8 feet; colour black with pale purplish stripes; length of joints $2\frac{1}{2}$ inches, circumference 4 inches; leaves light, 5 feet long, $2\frac{1}{2}$ inches broad, rather hard rind; stands drought well. Percentage of trash 40; juice 60 (5.5 gals.); density of juice 1.079; Arnaboldi (Beaumé $10\frac{1}{2}$).

41. *Brèheret*.—Of strong habit; 14 canes in each clump; height 8 feet; colour black; length of joints $2\frac{1}{2}$ inches, circumference 5 inches; foliage light; 4 feet long, $2\frac{1}{2}$ inches broad. The joints of this cane are strikingly short and heavy; it stands drought well, and would be very suitable for dry districts. Percentage of trash $33\frac{1}{2}$; juice $66\frac{2}{3}$ (6.2 gals.); density of juice 1.079; Arnaboldi 26 (Beaumé $10\frac{1}{2}$).

42. *Mamuri*.—Of strong habit and rapid growth, 30 to 40 canes in each clump; height 10 to 12 feet; colour light brown with the outer epidermal layer dry and chaffy; length of joints 4 inches, circumference $3\frac{1}{2}$ inches; foliage light; leaves 4 feet long, 3 inches broad; a clean, healthy, but somewhat peculiar-looking cane; stands drought well. Percentage of trash 34; juice 66 (6.1 gals.); density of juice 1.084; Arnaboldi 28 (Beaumé 11.1-5).

The Elephant cane continues to maintain its pre-eminence as a rapid grower with early maturity; but it requires very rich soil, a moist climate, and to be taken off as soon as it is ripe. It ratoons well the second year, but like most vigorous growers it requires to be renewed in the third or fourth year. In favourable localities the Elephant cane, where it has been tried, throws immense canes, looking almost like clumps of bamboos: the yield per acre has not, however, been quite equal to the show of canes, but it has yielded at the rate of two to two and a half tons of sugar per acre, which is far beyond the average of ordinary canes in Jamaica.

The Salangore cane is in fair demand by planters.

As a rule new canes are not kept sufficiently distinct on estates where they are tried, and hence it is very difficult to obtain reliable information as to their merits. It is very evident that unless each cane can be grown on a sufficiently large scale to allow it to be kept entirely distinct in the several processes of grinding and making into sugar, it is impossible to draw final conclusions from the results.

The introduction and experimental cultivation of new varieties of canes in a sugar-growing colony like Jamaica is an important element which I regret to say the planters, as a class, do not appear to realize so fully as they might. If, however, it is only kept steadily before their mind, the important fact that there are innumerable varieties of the sugar-cane plant, and that to obtain the best results each description of soil, whether loam, clay or gravel; each aspect, whether warm, cool or sheltered; each locality, whether dry, moist or wet, whether flat, sloping or steep, whether subject to spells of drought or continuously bathed in mist and moisture, whether warm and forcing, or cool and retard-

ing, whether possessing an equable temperature varying but slightly between day and night, or subject, as most closed-in valleys are, to great alterations between day and night—all these several conditions require their special variety of cane, and it is only by careful and systematic experiment, and by observant and intelligent culture, that these varieties can be found and utilized.

As one of the most important elements in the improvement of the sugar industry in Jamaica, it is a matter of regret, as already mentioned, that more attention is not given to the selection of certain varieties of canes, and the special adaptability of such canes to certain conditions of soil, aspect, rainfall, and climate.

Again, in the selection of cane plants it is a question whether the practice which obtains in Jamaica and some of the older sugar-growing countries of taking cane tops for the seasons' planting from thrown-up or exhausted fields, does not seriously affect the yield and productiveness of estates in this island. This practice, adopted probably in the first instance from motives of economy, is now continued and upheld, and, I may add, even warmly defended, as the most efficient and orthodox system of any for the intelligent sugar planter to pursue; but it is very probable that the continued planting of the immature portions of the sugar-cane in this manner has been in a great measure the cause of its deterioration, and that it has contributed a much larger share than is supposed, towards rendering sugar estates in this island less productive than otherwise they might be. It is a subject of general experience that the sugar-cane in common with most other plants is found to deteriorate in course of time, and this is no doubt due to careless cultivation, unsuitable soil and climate, and want of care in the selection of plants and tops. On the other hand, where a careful system of cultivation is pursued (by which is implied thorough tillage of the land, and the application of suitable manures), and where, after careful trial, a proper selection of plants is made and maintained, the most successful results have been realized.

It may possibly be remarked that just now, when the sugar industry is so depressed and expenses have to be kept at the lowest pitch, is not a favourable time for initiating any large departure from the established system of cultivation as hitherto pursued. The subject, however, is one which no one interested in the welfare of this important industry can overlook, and the sooner it is fairly and thoroughly investigated the better will the sugar-cane estates be able eventually to hold their own against the keen competition offered by those of the beet, the sorghum, and other sugar-yielding plants. Unless the best and most productive varieties of canes are adopted for cultivation; unless the most efficient and economical methods of tillage and culture are introduced and maintained; and, again, unless the manufacturing processes from first to last keep pace with the improvements so rapidly and effectually adopted in other countries, the

outlook for sugar-cane cultivation is far from what its friends would desire it, and far also from what might reasonably be expected from the natural advantages offered by the country for the successful prosecution of this important industry.

One of the chief means for effecting improvement in sugar cultivation in this island would be the establishment of usines or central factories, supported by sufficient capital to equip them with the best and more recent machinery, and to turn out sugars of the highest and best qualities. There are several localities, such as the neighbourhood of the Rio Cobre Irrigation Works, the Plantain Garden River district, Luidas Vale in St. John's, and St. Thomas-in-the-Vale, where central factories might be established, and where, in addition to canes grown by the factory itself, large quantities might be grown by European proprietors and settlers, and sold to the factory at a certain rate per ton: this rate being fixed each season in strict accordance with the yield of the canes, and the quality of sugar obtained therefrom.

The present sugar estates in Jamaica being small, and (with few notable exceptions) indifferently supplied with machinery, can ill afford to enter into competition with more favoured countries; and the only practical solution of the present difficulties would be larger and fewer estates, the establishment of central factories, and the fuller utilization of the labours of the small negro settlers by purchasing their canes, and working them up into the best class of sugars. With regard to the latter suggestion, I believe it is generally recognised that while the negro in many districts is disinclined to work regularly and continuously on sugar estates by task work, or for a daily wage, he is ever ready to cultivate his own ground, and to devote much time and labour upon it. Now if we were to take a hint from the beet-root growers, and by the establishment of central factories encourage the small proprietors and settlers to grow canes, and sell them at a fixed rate per ton, the factory by its more efficient and better machinery would be able to turn out the best qualities of sugar at a low cost, and compete successfully with other countries.

This cottier system (if I may so call it) of sugar-cane cultivation would, I believe, be the means of utilizing, to a fuller extent than has ever been done before, the labour power of the negro population in this island, and the subject is worthy of the serious attention of all those who have its welfare at heart.

I suppose that there is no cultivation with which the negro is more familiar, or one to which he takes more readily than that of the sugar-cane. At present this knowledge, as also the time and attention of the negro in the lowland districts, is expended in raising canes that are manufactured by the rudest appliances into the commonest and worst classes of sugar, fit only for local consumption.

Very few complete analyses of the entire plant seem to have been made, the test of the juice being usually deemed sufficient. The following is the composition of the entire cane:—

	Per cent.
Water	71·04
Sugar	18·02
Cellulose	9·56
Albuminous matter	0·55
Fatty and colouring matter	0·35
Salts soluble in water	0·12
Insoluble salts	0·16
Silica	0·20
	100·00

POPP FOUND IN RIPE SUGAR CANES from

	Martinique.	Central Egypt.	Upper Egypt.
	Per cent.	Per cent.	Per cent.
Water	72·12	72·12	72·13
Sugar	17·80	16·20	18·10
Glucose	0·28	1·30	0·25
Cellulose	9·30	9·20	9·10
Ash	0·40	0·35	0·42
	99·90	99·17	100·00

IN the JUICE of the CANE.

	Per cent.
Crystallisable sugar	19·64
Non-crystallisable sugar	0·30
Ash	0·25
Moisture	79·44
Organic matter, &c.	0·37
	100·00

ANALYSES of VARIOUS SPECIES of SUGAR CANE, MADE by DR. ICERY.

	Water.	Sugar.	Fibre.
	Per cent.	Per cent.	Per cent.
Diard	0·698	0·200	0·102
"	0·703	0·197	0·100
Guirogham	0·682	0·209	0·109
"	0·703	0·186	0·111
"	0·697	0·196	0·107
Pinang	0·678	0·196	0·126
"	0·690	0·198	0·112
Bellouget	0·716	0·197	0·087
"	0·703	0·203	0·094
"	0·729	0·197	0·084
Bamboo	0·695	0·190	0·115
"	0·669	0·214	0·117
Tahiti	0·703	0·210	0·107

The quantity of cane grown per acre weighs from 30 to 40

tons, so that with a percentage of sugar of 18 per cent., the crop of one acre would contain from 5 to 6 tons of sugar.

However, 18 per cent. is rather a high percentage, and in wet seasons, or in ratoons, the juice is not so sweet. 15 to 16 per cent. of sugar may be taken as more correct for a general crop, consisting partly of plant canes, and partly of first and second ratoons.

This would still give from 4 to 5 tons of sugar per acre; but unfortunately, planters seldom make more than 2 to 3 tons per acre, as a large quantity of sugar remains either in the megass, or is lost in manufacture.

The sugar-cane contains about 88 per cent. of juice, of which the best mills generally express only 70 per cent., and inferior mills only 60 to 65 per cent.; thus nearly 20 per cent. of juice is left in the megass, representing about 4 per cent. of sugar.

In an elaborate report on the yield of sugar in Réunion, on estates belonging to the Crédit Foncier Colonial, which are well managed, and which have first-class machinery, it is stated that of 16 per cent. of sugar contained in the cane—

4	per cent. is lost in the megass,
2½	per cent. is lost in manufacture and molasses,
and only 9½	per cent. of actual sugar is recovered.
16	per cent.

This result is still a very good one, for most *usines* make only 6 to 7 per cent. of sugar, or only about 50 per cent. of the actual percentage in the cane!

Professor Harrison, in his recent investigations on three different estates in Barbados, ascertained that about 40 per cent. of crystallisable sugar was lost. He found the cane to analyse about 17 per cent. of sugar, and the juice about 19 per cent.

The mills yielded from 59 to 65 per cent. of juice, thus over 20 per cent. of juice was left in the megass.

The juice is expressed by heavy mills, and various means are used to increase the yield, but it has not yet been possible to recover all, or nearly all, the juice the canes contain.

Much more satisfactory results are obtained in the manufacture of sugar from beetroots on the Continent, where the juice is extracted by diffusion, and this is one reason why beet sugar manufacturers have been able to compete successfully with cane sugar in spite of great natural disadvantages.

Of course bounties given by continental governments on exported sugar have greatly assisted the beet sugar manufacturers, and have been the means of encouraging the beetroot cultivation, but if planters in the colonies could only get all the sugar they grow, viz., 4 to 5 tons per acre, they would soon destroy the beet sugar industry in spite of bounties and other advantages.

Beetroots contain from 11 to 12 per cent. of sugar, and about

13½ tons of roots are raised per acre, yielding about 1½ tons of sugar.

The continental sugar factories obtain about 9½ per cent. of sugar,
and 2 per cent. of molasses.

11½ per cent.

Thus little or no loss of sugar is experienced.

The extraction of the juice by diffusion, which works so successfully with beetroot, has recently been also introduced in the colonies, and although it meets with great difficulties, it would appear that the general adoption of the diffusion process in the colonies may still be the means of enabling planters to hold their own in the sugar market.

Trials made with the diffusion process in Java have shewn that only 1 per cent. of sugar remained in the megass; therefore, of 15 per cent. of sugar which the cane contained, 14 per cent. was extracted by the diffusion process.

The trials are still being continued, and it remains to be seen whether this 14 per cent. can be turned into actual sugar; but it seems already to be settled that diffusion of canes is practicable, and any minor difficulties will no doubt be overcome in time.

A great consideration for planters is the question of fuel, which is so very expensive in the colonies, and hitherto the megass from the mills, after drying, has been nearly sufficient to boil down the juice. The megass obtained by diffusion is much wetter and difficult to dry to make it fit for fuel.

If other colonies would follow the example of the Java planters and make further trials with the diffusion process, no doubt rapid progress would be made in the improvements of manufacture, so that it may be possible in the end for planters to regain their former prosperity.

The enormous increase in the production of sugar will prevent prices from regaining for the future the former high level, and our colonies can only hope to compete successfully by increasing the yield, and reducing the cost of production.

AMERICAN PRODUCTION OF SUGAR.

British Guiana.—This is essentially a sugar-producing colony.

There were 105 sugar estates in active operation in 1885, having an aggregate area under cane cultivation of 75,344 acres. The sugar crop for that year yielded about 107,028 hogsheads. The sugar factories here are among the finest in the world. The crop of the colony, on an average, exceeds 110,000 tons; and in 1884 rose to 139,296. The sugars exported have justly a well-known reputation, the term "Demerara crystals" having become a household word.

All classes of sugar are manufactured in the colony, from the Muscovado sugar made by the old process of boiling in open kettles, and known to our ancestors as brown or moist, in distinction from lump or refined, to the clear white crystals, polarizing 99·50 per cent. of pure sugar, obtained by boiling *in vacuo* cane juice cleaned and clarified by the latest and most approved methods.

A sugar estate here is divided into fields of from 5 to 10 acres in extent by a series of cross canals, and the method of planting the cane is simple and easy when labour is at command. The brushwood and grass having been cut down and weeded, are piled into rows, 6 to 8 feet apart, across the intended beds into which the field is to be divided. These beds are formed by digging open small drains, 2 feet wide and 2 feet deep, at intervals of every 30 or 36 feet, across the entire field, beginning within a few yards of the canal, in the centre of the estate, and running to the side draining trenches, into which they empty themselves. The soil from these small drains having been carefully thrown upon the beds, so as to raise and round them off in the middle, narrow banks or ridges of earth are made across them, from drain to drain, parallel to and equidistant between the rows of grass and brushwood; and in these spaces, between the banks of earth and grass, the canes are planted in line, each line being 3 or 4 feet apart, and each cane plant 9 or 10 inches from the next. The plants are procured by cutting off the tops or upper joints of growing canes into lengths of 10 or 12 inches, which are thrust in a slanting direction into the well-stirred ground, and in ten days or so the long grass-like leaves begin to spring from the eyes at every joint. These young canes require to be kept well weeded, and moulded about the roots from the ridges of earth or decaying grass on either side of them, which had been previously prepared for that purpose; and this must be repeated as long as there is room for the labourers to pass between the rows, which, according to the season, will be until the plants have attained the age of six or eight months, after which time the spreading of numerous leaves from each stock will have covered the surface of the field with so dense a jungle as in a great measure to prevent any further growth of weeds. When about nine months old, the cane throws out its "arrow," a long reed-like stem, surmounted with a tuft of waving downy blossom. At this period the plant is poor and weak, and little more than a mass of water; it soon, however, recovers, and in twelve or thirteen months from the time of planting is considered at maturity, having then sometimes attained a length of 20 to 25 feet, but more frequently of 10 or 12 feet, about as thick as the wrist, and divided into joints like a bamboo. When ripe, the canes are cut down to the very ground, in lengths of 3 or 4 feet, and thrown into punts, which are towed along the canal by mules or oxen to the wet dock at the door of the sugar mill. Immediately after cutting, the large quantity of "trash," or dry leaves, is rolled clear of the cane stumps, and heaped in rows, there to decay and form a rich manure for the succeeding crop. In a few days the

stumps throw out their shoots, and the same routine of cultivation is repeated for twelve months more, any vacant spaces where plants may have missed being carefully supplied. The canes of the first year are called "plant canes," those of the second and subsequent years being distinguished as "ratoons"; and these ratoons have been known to be produced from the first plant for twenty years and upwards, the canes having been annually cut down and the stumps allowed to shoot again. But this continued reproduction from the same stocks of course causes the canes to degenerate, and to yield less abundantly. An acre of newly planted land will give 2 tons of sugar for the first year, gradually falling off to not more than one-fourth of that quantity as the stocks become old. The productive power of the greater part of the soil of British Guiana, indeed, appears to be unlimited. As an instance, it may be mentioned that, on an estate in Essequibo, the return obtained in 1851 from certain lands, which had been properly worked and perfectly drained, amounted to a fraction within 4 tons of sugar per acre.

The plan on which a sugar estate in this colony is laid out is described in the first 'Report on Thorough Drainage,' by the late Dr. Shier, agricultural chemist to the colony:

"The plantations are generally narrow rectangular strips of land with a façade or water frontage on the coast, the rivers, or canals. The façade varies from 100 to 300 Rhyndland rods (12·32 feet).

"Exceptional cases occur where, from an estate being prevented from extending far back, extra façade has been allowed, giving to the estate more of a square form. Every estate is bounded by four dams; the front dam, excluding the sea, river, or canal; the back dam, parallel to the former, and excluding the bush water, which, in heavy weather, is very considerable, and would inundate the cultivation. The clay thrown out in forming the adjacent canals or trenches affords the material of which the dams are formed. Along each of the remaining sides there runs a dam from front to back. The produce is brought to the buildings (often situated in front) by canals. In fact, water transport of produce is universal. The arrangement of the navigation system is very simple. From front to back, and right in the centre of the estate, there runs a dam called the middle walk, with a canal on each side of it. These are termed centre canals, and are wide enough to admit of two punts passing each other. The dam forms a path for the cattle that draw the punts. At regular and comparatively short intervals branch canals strike off at right angles from the centre canals, and proceed to within a rod of the draining or side-line trenches, which are parallel to the side dams before described, and adjacent to them. These branch canals constitute the transverse boundaries of the fields, and navigation canals thus lie on three sides of every field, and admit of canes being carried by a short path to the punts. On some estates there is only a single centre navigation canal. These canals are principally supplied by the rain, but in protracted droughts, and especially when they are shallow, they are liable to

run short of water; hence whenever access can be got to creek, lake, or bush water, it is brought from behind to supply the navigation system. In other instances salt water has to be taken in from the front when a cane crop cannot otherwise be got off the ground. The drainage of an estate is equally simple. From back to front, and immediately adjacent to the side-line dams, run the two main draining trenches, generally dug considerably deeper than the navigation canals. The small drains, again, cut at distances two to three rods apart, commence within a bed of the middle-walk side of the field, and terminate in the side-line draining trenches, being dug with a fall in that direction. The small drains are thus at right angles with the main draining trenches. In the front dam the sluices or kokers are placed. Sometimes there is only one on an estate, but generally two, one at the end of each draining trench. The main draining trenches are generally connected together by a trench running along behind the front dam."

The old processes employed in the manufacture of sugar are as follow:—

The cane-juice is received from the mill into cisterns or boxes, where such a proportion of lime is added as is considered necessary for its proper defecation. It is thence run into a series of cast-iron vessels called "coppers," which are built into brickwork, and heated by the direct action of a single fire in the ordinary manner. In these the juice is, as far as possible, cleansed by means of skimming, and evaporated down, until it has reached that degree of concentration technically known as the "striking point," when it is transferred into shallow wooden vessels and allowed to crystallize.

Bisulphite of Lime.—This agent has been used in the manufacture for many years, but at the present time much more extensively than ever. It is in some cases used even when the ordinary process is followed. There are several establishments in or near Georgetown for the manufacture of bisulphite of lime, so great is the demand. The apparatus for the manufacture of sugar is now wonderfully compact and perfect. The improvements likely to be made will, no doubt, be in the substitution of shallow evaporating vessels for the taches or teaches at present in use.

As an improvement upon this rude process, separate defecating vessels or clarifiers, heated either by steam or by the open fire, have been introduced on the majority of estates, and in some instances vessels in which the defecating liquor is allowed to subside previous to being run into the coppers, have also been used with advantage.

For upwards of forty years vacuum pans have been in use on some plantations in this colony. Of late years their use has been greatly extended, and, from present appearances, it is likely that at no distant date no important estate in the colony will be without one. The advantages attending the use of the vacuum pan are chiefly these:

(1) A much more speedy manufacture of sugar than by the ordinary process.

(2) The production of a sugar (grocery quality) which goes directly into consumption, without passing through the hands of the refiner.

(3) The avoidance of all loss from drainage on the homeward voyage.

The loss from drainage of molasses of common process sugars is estimated at 10 per cent. of the original weight.

On plantations where the vacuum pan is used the process may be thus stated: As the cane-juice falls from the mill rollers it is mixed with a certain proportion (half per cent.) of bisulphite of lime. It is then thrown up to the clarifiers, and boiled by means of steam. A due amount of milk of lime is added, and the contents of the clarifier allowed to remain at rest (half an hour) till the impurities have settled, when the clear juice is run down to the copper wall. In some cases filtration through bag filters is practised as the juice leaves the clarifier. On some estates the contents of the clarifiers, at a boiling temperature, are run into subsiding vessels, in which the sediment takes place, from which the juice passes either through bag filters, or at once to the copper wall. On the copper wall the cane juice is evaporated to a density of from 25° to 30° of Beaumé's saccharometer, when it is either taken directly into the vacuum pan or is first passed through bag filters. When the syrup is sufficiently concentrated in the vacuum pan, *i.e.*, crystals are formed to the satisfaction of the pan boiler, the contents are run into shallow wooden coolers, and after a short time transferred in portions to the centrifugal machines, in which it is freed from molasses. In some cases, while in the centrifugal machines, syrup is used to brighten the colour, and in other cases a small quantity of water. The sugar is then removed from the centrifugal machines, and at once packed into hogsheads. The sugar thus manufactured in this colony is of a pale straw colour, uniform crystal (not too large) of great brilliancy, and dry.

From the various improvements introduced, the manufacture of sugar is now a very speedy process; for instances are known where from canes in the field in the morning, the sugar has been on shipboard before night.

The late Sir R. Schomburgk, in an interesting pamphlet on British Guiana, observes that 8 hogsheads of sugar per acre is an ordinary crop, 5000 to 6000 lbs. (53 cwts.) per acre not extraordinary; and that on an estate called "Mary's Hope," on the Courantyne coast, 8000 lbs. = $73\frac{1}{4}$ cwts. have been produced. In British India the produce is only from 12 to 15 and 20 cwts. per acre, on the very best land. In Trinidad the produce cannot be estimated at less than 20 cwts. per acre.

DISTILLATION OF RUM.

The quantity of rum manufactured in British Guiana is very considerable. Formerly it was estimated that for every hogshead of sugar produced by an estate, there should also be produced a puncheon of rum. This estimate still holds good on estates where the ordinary process of the manufacture of sugar is practised; but on estates where improved methods, with the use of the vacuum pan, are followed, the quantity of rum does not exceed one-half of this old estimate. The great object of proprietors is to extract the largest amount of sugar from the cane juice, and diminish as much as possible the production of rum and molasses.

The rum produced in Demerara does not bring so high a price in the market as that of Jamaica; not that less skill is employed in its manufacture, for no expense has been spared to obtain the best machinery and make use of the best methods. The reason of the inferiority arises chiefly from two causes:

(1) From the very impure cane juice obtained from the sugar-cane grown in the colony. So much salt still remains in the soil that on many estates the presence of salt in the cane juice can readily be perceived by the taste.

(2) From being unable to employ water for condensing the spirit at a lower temperature than 84° Fahrenheit.

In Jamaica the spring water brought from the mountains is of a much lower temperature.

10,349 puncheons of molasses were exported from Guiana in 1885.

Jamaica rum is the finest in the world, holding the first place in all markets for quality and merit, and commanding a higher price than the rum of any other country. It has always carried off the highest awards at the different International Exhibitions where it has been shown. In the year 1834 as much as 3,500,000 gallons of rum were exported from Jamaica. Between 1870 and 1880, the average annual export was about 20,000 puncheons of 84 gallons. Since then the quantity shipped annually has ranged between 1,500,000 gallons and 2,000,000 gallons. In 1885 2,080,471 gallons were imported into England. In addition to the rum exported, about 4000 puncheons are yearly made by the large proprietors for home consumption.

Jamaica has an advantage over all other cane-growing countries, its rum being worth from two to three times the price of the rum of other places. As first-class rum pays better than sugar, it is an object with the Jamaica planter, in most cases, to make a great quantity of rum, and on many estates as large a proportion as he can without injuring its quality. In 1838 the proportion of rum made was about 36 puncheons to every 100 hogsheads of sugar, now about 176 puncheons are made to every 100 hogsheads. The average quantity made yearly in Jamaica for the last ten years has been about 25,000 puncheons. This is chiefly to be ascribed to the adoption of the centrifugal machine, and other

improvements, by which a larger proportion of molasses than hitherto has been saved and utilized in the distilleries.

Formerly England received nearly all the rum shipped from Jamaica, but during recent years the United States and Germany are becoming direct importers on a considerable scale.

The small settlers do not manufacture rum from the sugar produced by them, as the working of stills of a smaller capacity than 300 gallons is under such legal restrictions, as almost to be prohibitive. In 1855 we imported as much as 8,714,337 gallons of rum, but now we do not receive so much. All sugar-producing colonies make more or less rum, but the smaller colonies use up locally what they make. Of 6,378,000 gallons received in 1887 nearly all came from our own colonial possessions. In 1886 British Guiana sent us 2,851,000 gallons of rum, and the West Indian islands 1,600,000 gallons. It is curious to notice how this single colony is outstripping the West Indian islands in the distillation of rum. Ten years ago the quantity was about equal: now Demerara has doubled its production, and surpasses the other sugar colonies combined. In 1885 British Guiana exported 28,353 puncheons, against 33,400 puncheons in 1884. The largest shipment was 36,219 puncheons in 1876.

In Trinidad only 13,000 gallons of rum were exported in 1876, but the quantity shipped had increased in 1885 to 72,525 gallons. In Tobago there are thirty-two stills on the sugar estates, but only seventeen in operation. In 1857 St. Kitts exported 681,857 gallons of rum; and in 1882 only 287,284 gallons; British Honduras has thirty stills on the sugar estates, but only exports about 28,000 gallons. Ten years ago, Mauritius shipped 1,000,000 gallons of rum, but now exports 30 per cent. less. The French sugar colonies send their rum to France. Guadaloupe produced, in 1885, 600,000 gallons; Martinique, 3,000,000 gallons; Réunion, 700,000 gallons. In some of these colonies rum passes under the name of Tafia and Guildive.

Cuba exported, in 1880, 9,873 pipes of rum of 125 gallons.

About 4,000,000 gallons of rum are taken annually for home consumption in the United Kingdom, and the supply of the Royal and Merchant navies.

From Brazil the exports of rum have been as follows:

	Gallons.		Gallons.
1839-40	1,509,170	1880-81	676,250
1879-80	827,082	1881-82	530,250

Formerly the molasses from British Guiana was exported to Great Britain and purchased by refiners, but lately a great deal has been sent to the United States, where a higher price has been obtained. It may also be stated that a considerable proportion of the sugar of the colony has gone to the same market.

Rum when rectified is colourless and possessed of a peculiar odour, arising, it is said, from an essential oil contained in the rind of the cane, and which finds its way, in the skimmings of the cane

juice, during its evaporation, in the sweets used in setting up liquor for fermentation. Rum is coloured by caramel prepared from good muscovado sugar.

The proper manufacture of good colouring matter for rum is very important. For this purpose the best sugar should be selected, and placed in sufficient quantity in a pan on an independent fire. The sugar must be constantly stirred with a wooden paddle during the action of the fire on the pan, in order to prevent its getting a singed taste or flavour; and when it comes to a consistency, making it difficult to keep it in motion with the paddle, the fire must be withdrawn, and high wines gradually added to it, under the agitation of the paddle, until it comes to a consistency of thick cream, so that the whole will be perfectly dissolved. After this, it should be put into a cask placed on end, with two cocks, one about 6 inches from the bottom of the cask, the other about 2 inches from the bottom, and allowed to remain undisturbed, in order to its depositing the sediment left in it, until it runs off from the upper cock entirely free from sediment. It may then be used for colouring the rum, and about three pints of good colouring matter, well concentrated, ought to be sufficient for 100 gallons of spirit; but different markets require different shades of colour, and to regulate the shade of colour must be left to the judgment of the person entrusted therewith. Great care should always be taken that the colouring matter does not impart any cloudiness to the rum, because when rum is cloudy the value of it is very greatly deteriorated.

Colouring matter should be made in large quantity, because the longer it is kept the purer it becomes. The strength of the rum generally exported is about 35 per cent. overproof.

French Guiana.—Sugar cultivation has been almost abandoned here. In 1885 there were less than 100 acres under sugar cane, and the produce was but 100,000 lbs. of sugar and a little rum.

Surinam.—Sugar is the staple product of this Dutch colony, and the manufacture is steadily carried on, although the production of sugar shows no increase, the average crop being about 10,000 to 12,000 tons per annum.

Several of the wealthiest owners of estates have introduced the vacuum-pan process, making their sugar thereby, and thus rendering it more marketable and of higher value. They have also been erecting first-class distilleries on their estates, as, the price of molasses being low, they find it more profitable to distil than to sell the molasses.

Guatemala produces about 2000 tons of sugar yearly.

Brazil.—Sugar is one of the great articles of export from Brazil, but it has not made the same progress that coffee has done; its culture has indeed in some provinces been stationary, owing to the preference given to the growth of coffee and cotton, which are for many reasons supposed to be more advantageous to the planter, as requiring less capital and labour. The culture of the sugarcane is in general carried on in the most primitive manner, and,

owing to the rudeness of the machinery and the want of knowledge of the latest and most improved processes of manufacture, the quality of Brazilian sugar is, with some few exceptions of note, greatly inferior to that of other American countries. However, in this as in most other matters, the Brazilians are seeking to put themselves on an equality with other nations, and many enterprising planters are availing themselves of the latest improvements that machinists and scientific men have placed at their disposal.

The variety of cane grown by preference in this country is the Salangore, as the Cayenne cane, so long in use (from the negligence exhibited in its culture), became a victim to the epidemic that attacked it, whereby it lost all its saccharine qualities. But all recent introductions in Brazil present the same phenomena at the onset as was the case with the Cayenne cane; and new substitutes will be of little avail if the method and care in its cultivation be carried out in the old fashion.

About seventeen varieties of this plant have been acclimatized and cultivated in Brazil, and considerable quantities of plants are annually distributed to planters by the Imperial Institute of Agriculture.

The whole belt of soil from the Amazon to San Paulo is suitable to the cultivation of the sugar-cane, although it is more fully developed in the northern provinces of Pernambuco, Alagoas, Sergipe, Bahia, and Rio Janeiro.

Its cultivation is remunerative, especially the species called Salangore, which yields 11 to 14 per cent. of juice. An active, intelligent labourer is supposed to take care of two hectares. The cost of production in Rio, where wages are high, is about £14 per hectare. In the manufacture of sugar great advantage has attended the use of steam as the boiling medium of liquids at a low temperature, and that of turbines for the forced clearing of the crystallized material.

The old system of planting, as handed down from colonial days, is carried on, but there are indications of an awakening spirit to adopt superior methods. Ploughing and manuring, as understood by an Englishman, are almost entirely ignored. There are within the province of Bahia 1400 "engenhos" for manufacturing sugar, besides a great number of small growers, who make a coarse sort of sugar (rapadura), in ordinary use among the population of the wild extent of this country, and not brought to market.

Nearly all the soil of Brazil, especially those provinces situated between Rio Grande do Nord and Rio Janeiro inclusive, are especially favourable to the growth of the sugar-cane. Often the plantations last sixteen to twenty years, yielding good results. At Matto Grosso there are plantations of forty years' cultivation which are yet vigorous in production. The sugar-cane reproduces itself with such intensity in this province on the borders of the rivers, that it is often necessary to prune the canes. The culture of the cane is profitable in Brazil, even in silicious soils which are less favourable for the growth. In newly-cleared lands there will

be often obtained at the end of fifteen months 20 tons of cane per hectare (of $2\frac{1}{2}$ acres). Fifty or sixty central sugar works have been established in fourteen provinces, which means a guaranteed interest from Government of 7 per cent. on their capital.

The larger planters manufacture their molasses into rum, and many of the small growers produce a superior quality of spirit (tafia) which is much prized.

The average export of sugar from Brazil in the twenty-five years ending in 1865 was 41,000 tons. The total from 1864 to 1872 averaged 142,000 tons, but in late years the production has doubled—reaching 250,000 tons. The exports were:—

							Tons.
1879-80	..	..	..	..	..	..	100,000
1880-81	..	..	..	..	..	..	80,000
1881-82	..	..	..	..	..	..	123,000

British Honduras.—The soil of this colony allows the sugar-cane to ratoon freely for, it is said, thirty years, and produces two to three tons on the average to the acre annually for the first two or three years.

The number of estates, as well as the area actually under canes, has greatly diminished. In 1876 there were 9636 acres under cane; there are now only 2300 acres, and twelve estates have dwindled down to four or five. The exports of sugar have averaged the last few years about 2000 tons, and the rum shipped has dropped from 66,000 gallons in 1871 to 3577 gallons in 1881.

The chief cause of this decline is the labour supply and the competition between mahogany culture and the planters. The Bourbon cane is that exclusively cultivated here.

The sugar-cane succeeds very well in most of the countries of Mexico and Central America, south of 28° . The most productive plantations are on the declivities of the table-land, and in the lower plains to the elevation of 5400 feet above the sea; but in places well sheltered the sugar-cane grows nearly as high as 7000 feet. The plantations are most numerous in the valley of the Rio Santiago, and on the plains towards the Pacific. Their produce is very considerable, but nearly the whole of the sugar is consumed in the country.

Colombia.—The sugar-cane has hitherto been cultivated in Carthagená only in small quantities for making rum and a spirit called anisado. The climate and rich soil are peculiarly adapted to the growth of the sugar-cane. The chief difficulty is labour, and they have imported Indian coolies from Jamaica. Mexico produces about 5000 tons.

The sugar-cane is among the chief objects of culture in Salvador, the export of sugar ranking third of the articles of commerce. Land is cheap and labour plentiful. The machinery erected in the large sugar factories is of the finest English or German make, with all the latest improvements. The native mills are, however, of wood, worked by oxen. The juice extracted

is boiled over open fires until it granulates. Directly the rainy season is over, in November and December, the ploughing begins. When once planted, the cane yields from five to eight crops before it is exhausted, and where the land is very rich it has been known to yield in succession eighteen to twenty crops. A manzana (100 square yards) is estimated to produce about 1500 cwts. of canes, yielding from 9 to 10 per cent. of sugar.

The agricultural future of Guatemala lies in sugar. The cane grows well, and is unusually full of saccharine matter; sugar land is abundant; labour is generally cheap, although somewhat scarce; and roads and railways, to secure exportation, are being slowly but surely made. 44,000 quintals were exported in 1883, and it has been stated that, in spite of the expense of conveying it to the coast and placing it on board ship, the greater part of it realised a profit of £2 a ton in London. The following statistics are furnished by the Government for 1883:—2247 estates, with an extent of 13,667 English acres, planted with cane, produced during the year 154,595 arrobas (an arroba equals 25 lbs.) of sugar, valued at 1 dol. 75c. the arroba; 67,183 loads of “panela,” unrefined brown sugar, valued at 8 dols. a load; 159,184 arrobas of syrup at 25 c. the arroba; and 64,497 quintals (a quintal equals 100 lbs.) of muscovado, valued at 2 dols. the quintal.

Venezuela.—This State has never been a sugar-exporting country, and the export which has been carried on may be said to have been almost exclusively confined to brown or muscovado sugar.

The variety of cane chiefly cultivated here is the Otaheite, which has superseded the Creole cane. There are about 100,000 acres under culture with sugar-cane. The production in 1884 was 76,320 tons, nearly all of which, as well as the rum made, was locally consumed, the exports of sugar being now only 681 tons. Some years back, owing to a demand, 1000 to 2000 tons were exported.

Peru.—The sugar-cane grows here with the greatest luxuriance; the cultivation is regulated by irrigation, and the cane grows without intermission by ratoons. The cane has 65 per cent. of juice of an average density of 10 degrees. In Northern Peru a ton of canes gives 200 gallons of juice, yielding 1·35 lbs. of sugar per gallon, or 270 lbs. from a ton of canes—8½ per cent. The first planting in Northern, or more tropical, Peru takes fifteen months to mature, after that twelve months; but in Southern Peru the first plant canes take twenty-four months to mature. Three or four ratoon crops are obtained before replanting is necessary. The green and the ripe cane are seen in the same field (though the best season for planting is November); they may be cutting at one end and planting at the other, so that the ground is never idle.

Manufacturing the sugar is carried on for eight months, the rest of the year being given to repairing the irrigation channels, the buildings, &c. These particulars refer to the Pacific slope of the country and its lower part. The cane is cultivated on both; but, while it will grow at 6500 feet elevation on the eastern slope, 4500 is its limit on the western slope. In some of the mountainous

parts of the former the juice will not crystallize, and is distilled into rum (aguardiente), of which the natives are very fond. There it ripens in seven or eight months from planting. The great sugar district is in North Peru, west slope. There are about 130 large sugar estates on the coast.

The average yearly produce there from 1869 to 1873 was about 36,000 tons; from 1875 to 1880, 68,092 tons. The crop in 1875 was 60,000 tons, and, 1876, 70,000 tons; about 6000 tons go to Chili. The average total crops were in

						Tons.
1853-67	..	..	..	..	..	42,078
1869-73	..	..	..	..	..	61,863
1875-80	..	..	..	..	..	84,496

Louisiana.—In 1872-73 the crop was 108,520 hogsheads of sugar, and 8,890,640 gallons of molasses, made by 1181 sugar-houses; since then the production has been

					Hogsheads.					Hogsheads.
1874	..	..	..	..	116,867	1880	..	..	..	218,314
1875	..	..	..	..	144,146	1881	..	..	..	122,982
1876	..	..	..	..	169,331	1882	..	..	..	241,220
1877	..	..	..	..	127,753	1883	..	..	..	221,515
1878	..	..	..	..	213,221	1884	..	..	..	170,431
1879	..	..	..	..	169,972					

The product of a hand on a sugar estate is put down at the cultivation of 5 acres, producing 5000 lbs. of sugar and 125 gallons of molasses. Two crops are made in succession on the same land, one of plant cane and one of ratoons; it then lies fallow two years, or is planted with Indian corn or peas. An acre yields about 1200 lbs. of sugar.

While the sugar-cane contains nearly twice as much sugar as the beetroot, in the process of extraction more sugar is obtained from the latter than the former. Millions of pounds of sugar are thrown away in Louisiana every year. The sugar exists in the cane in a crystallized form, and cannot be pressed out. It must be dissolved out by water. The fact that the Louisiana sugar industry needs the aid of science fully to develop the wealth of the State need not be longer concealed. The agriculturists of Europe call in science to their aid, and are thus enabled to compete with their less enterprising competitors who are blessed with superior natural advantages.

The following figures are well worthy of perusal. They are from parties well versed in the subject. The amount of beetroots contained in an acre weighs, on an average, 30,000 lbs. The cost of cultivating beetroot in Germany is 16.55 francs; the internal revenue, 19.95 francs—6.70 dollars per ton of 2200 lbs. Cultivation of beetroots in France, 18 francs; internal revenue, 32.35 francs—10.07 dollars for 2200 lbs. Percentage of sugar in roots in France, 5 to 12 per cent.; percentage of sugar in roots in Germany, 6 to 13 per cent. The internal revenue is in France fixed on the juice after it is extracted from the beets; in Germany

it is levied on the weight of the beets. Quantity of sugar manufactured from 100 lbs. of beets in France, 7 lbs. = 14.28 per cent.; quantity of sugar manufactured from 100 lbs. of beets in Germany, 8 lbs. = 12.5 per cent. In both France and Germany the average per cent. of molasses is 3.33 per cent. An acre of sugar-cane (canes that are brought to the sugar-house to be manufactured into sugar) costs in culture in Louisiana 50 dollars. In one season 148,740 acres of canes were taken to the mill in Louisiana. The average quantity of canes per acre was 44,058 lbs., and the cost per 2200 lbs. 2.50 dollars. That year 6,553,108,807 lbs. of canes were passed through the mill; the juice produced had a density of 8° Beaumé, equal to 14.4 per cent. of pure sugar per 100 lbs. juice; but only 12.96 lbs. of sugar for the 90 lbs. juice contained in 100 lbs. of canes. When the sugar is drawn from the batterie or strike-pan it contains water of crystallization equal to 15 per cent., which, added to the 12.96 of sugar, are thus divided:—8.942 sugar, 5.962 molasses—14.904 per cent.

The question now comes, Can machinery be made that will extract the whole of the sugar from the cane? Many of the machineries now in use in Europe for the manufacture of beet sugar would exhaust almost the whole of the saccharine contained in the sugar-cane. But those apparatus cost very high in money, and require a great many hands to work them; presses to operate on 500,000 lbs. cane in 24 hours would necessitate from 48 to 50 hands to attend to them; to the juice water must be added at the rate of 25 to 30 per cent. The quantity of sugar left in the pulp, from 1 to 1½ per cent. Diffusion to work the same quantity of cane would require, to attend the diffusion vessels, &c., 20 to 25 hands; some 20 per cent. of water is added, and the cosettes or slices return ½ per cent. of sugar. The use of centrifugals or turbines to displace the saccharine from the pulp would be very costly. A sugar-house to work 500,000 lbs. (nearly 230 tons) cane per day would require 115 hands, to be all the time on duty. The cost of a beetroot manufactory is from £32,000 to £40,000, and some run as high as £160,000, £200,000, and even a great deal more. One in the Grand Duchy of Baden, "Waghausel," manufactures nearly 60,000 tons of sugar yearly, and has cost over £1,000,000. Many of the planters are of opinion that beetroots would be profitable in Louisiana as a sugar-rendering plant, and could be cultivated in lieu of the sugar-cane. Sugar could not be made from beetroots with the existing machinery. Peligot is right when he says: "If in Europe we had the sugar-cane, we would furnish sugar to the world, and so cheap as to defy competition." The apparatus used in Cuba will do better than either presses or diffusion, the tanks being so constructed that a very dense juice is produced. If the mill would give juice at 8° Beaumé, the displacement apparatus with the same canes would furnish juice at 8° 5 to 9° Beaumé. If more fuel is required, it is simply because a larger quantity of sugar is produced. Two or three hands can work the apparatus. Only one-half of the power is required to slice canes that is now used to press the cane with.

rollers. The bagasse or trash used in Cuba contains 13.5 lbs. of sugar to 100 lbs. bagasse (each 100 lbs. of canes giving 40 lbs. bagasse, 250 lbs. canes gave the 100 lbs. bagasse), and a little over 10 lbs. of the 13.5 lbs. of sugar were extracted. Had sliced canes been used instead of bagasse, the exhaustion would have been much more complete. In evaporating sugar in Louisiana, fuel equal to 1 lb. of coal is used to evaporate 3 lbs. of water. In Europe 1 lb. of coal evaporates 6 lbs. of water in manufacturing beetroot sugar.

The following details of the sugar-cane, its contents, and the manufacture of sugar from it, are well worthy the attention of all interested in its culture:—

1240 gallons of juice at 8°·5 Beaumé produced on a plantation 1048 lbs. of sugar and 480 lbs. of molasses.

One gallon of juice at 8°·5 Beaumé will weigh 8.96 lbs. avoirdupois. Therefore, 1240 gallons of juice will weigh 11,111 lbs.

100 lbs. of cane contain 90 lbs. of juice; then 11,111 lbs. of juice are produced by 12,345 lbs. of cane.

At 8°·5 Beaumé the juice contains 15.3 per cent. of pure and dry sugar. If so, 11,111 lbs. of juice, having that density, will produce 1700 lbs. of sugar.

When the sugar is taken out of the boiler it is combined with water of crystallization, which being added to the 15.3 per cent. of pure and dry sugar = 17.595 per cent. of sugar and molasses; of this three parts are sugar and two parts are molasses, and we have for the 11,111 lbs. of juice at 17.595 per cent. = 1655 lbs., of which 1173 are sugar, and 482 molasses.

This plainly demonstrates that the loss in the manufacturing was 427 lbs. of sugar and molasses. Also, we can perceive that with 11.8 lbs. of cane, 1 lb. of sugar and 0.48 of a pound of molasses were produced; that, had there been no loss in manufacturing, 10.5 lbs. of cane would have produced 1 lb. of sugar and 0.66 of a pound of molasses; and that, if no molasses had been produced, but the whole juice had been converted into sugar, 1 lb. of sugar would have been produced by 7.26 lbs. of cane.

The land, according to quality, can grow or produce in Louisiana from 13,000 to 45,000 of canes to the acre; the length of the canes will vary from 3 to 8 feet, their weight being on an average 10 ozs. avoirdupois to the running foot.

Canes 4.5 feet long, weighing each 3 lbs., and growing 350 per row, of 100 feet long, would give 61,125 lbs. to the acre. As an average, the acre can be set down at 60,000 lbs.

When canes are cut before they are injured by the cold, they can be kept for making sugar from three to four months. They lose some of their water of vegetation; the sugar does not change in the least, and stays in perfect preservation.

The joints of a cane that has dropped its leaf contain only crystallizable sugar. The buds, or young suckers of the joints, produce the larger part of the colouring matter found in the juice. In Louisiana the density of the cane juice varies from 6° to 10° Beaumé, 8°·5 Beaumé being the average; 15.33 per cent. of

pure, dry sugar. Different species of cane contain from 12 to 16 per cent. of vegetable fibre, and hence from 84 to 88 per cent. of juice.

With displacement of methodical washings, the sugar contained in the sugar-cane can be easily exhausted. When thoroughly defecated, the juice of the cane is very easily manufactured into sugar, and the whole of the sugar-cane can be made to crystallize.

The planters require from 35 to 55, and even more, pounds of cane to make 1 lb. of sugar and 0.66 of a pound of molasses. The average for the State is 2.25 lbs. of sugar and 1.50 lb. of molasses to 100 lbs. of cane.

It has been demonstrated that 10.5 lbs. of cane can easily produce 1 lb. of sugar and 0.66 of a pound of molasses; then 6,000,000 lbs. of cane will produce equal to

571,428 lbs. of sugar, at 8 c.	\$	c.	\$	c.
380,952 lbs. molasses, at 4 c.	45,713	24	15,238	08
			60,951	32
Expenses, culture	5,000	00		
Manufacture	11,951	32		
Taxes, overseer, engineer, &c. ..	2,000	00		
			18,951	32
Total			\$42,000	00

Six million lbs. of cane manufactured into sugar of firsts, seconds, &c., would produce 750,000 lbs. of white sugar and 140,000 lbs. molasses.

Concrete sugar contains 10 per cent. less water than ordinary sugars, which usually have sugar three and molasses two parts. Thus, 6,000,000 lbs. of cane manufactured into concrete would produce 867,510 lbs. of sugar.

India.—The sugar-cane is a native of India and Indo-China, where it was exclusively cultivated from remote ages down to the middle of the thirteenth century. At this period the trade extended itself into the countries beyond the Ganges, and the cultivation was speedily taken up in Arabia, Syria, and Egypt. Gradually the plant was introduced into Cyprus and Sicily, and thence into Madeira and the Canary Islands, ere long becoming in Spain a favourite object of culture. In the beginning of the sixteenth century the sugar-cane was imported into St. Thomas and St. Domingo, where its culture was rapidly developed, and a systematic trade established in those colonies.

The sugar-cane was doubtless known in India from time immemorial, and grown for food, as it still is in the present day, chiefly in those regions which are unsuited for the manufacture of sugar. From the elaborate investigations of Ritter it appears that it was originally a native of Bengal and of the Indo-Chinese countries, as well as of Borneo, Java, Bali, Celebes, and other islands of the Malay Archipelago; but there is no evidence that it is now found anywhere in a wild state.

The extraction of the juice from the cane—the first step toward

the manufacture of raw sugar—was in early times effected by the rudest appliances. The stump of a tree, the upper part of which was carved into a rude resemblance of a human head, was regarded as a deity, which enabled the ancestor of the poor ryot of the present day to obtain the juice which would yield the much-prized sweet crystals. Into the hole representing the mouth of the figure, or into one made lower down, was inserted the end of a long pole, which served as a lever to crush the juice from a piece of cane placed between it and the stump. The Buck Indians or Caribs of British Guiana, it is curious to remark, now employ an almost exactly similar contrivance for a like purpose.*

This ineffectual method gave place to one by which the juice was crushed out in a mortar. The primitive mill still used in Dinajpur is an adaptation of this plan, and is constructed as follows:—A sound tamarind tree being selected, is cut down at about two feet from the ground, where it may be a foot and a half or more in diameter. The stump is then hollowed out in the form of a mortar, and from the bottom of the hollow a hole is bored a little way perpendicularly. The exterior of the stump is next pierced by a hole which meets the previous boring obliquely, and thus affords an outlet for the juice, which runs into a strainer fixed over an earthen pot sunk in the ground amongst the roots of the tree. The pestle, it is to be observed, does not pound the pieces of cane, but crushes or squeezes them. It consists of the trunk of a tree, some 18 or 20 feet in length and about a foot in diameter, rounded off at the larger end, which is placed in the hollow of the mortar in an inclined position. A pair of oxen are yoked to a horizontal pole, which is supported at the outer end by a bamboo hanging by a notch made in the root end from the upper and smaller end of the long pestle, while the other end is attached by a loop to a bamboo hoop which encircles the stump, and thus acts as a runner. The pestle, therefore, forms a double-armed lever, the fulcrum of which is situated at the edge of the mortar, the cane being crushed between the sides of the pestle and mortar respectively. The force with which the pestle acts is increased by the driver sitting upon the outer extremity of the horizontal pole, and sometimes by weights being added. Such a machine, however, is totally ineffectual to crush the cane until it has been first cut into small pieces. To this end a bamboo stake is driven firmly into the ground and a deep notch made in the end projecting upwards. The attendant passes the canes through this notch, which slits them longitudinally, while he cuts off the slit canes, in lengths of about a foot each, with a rude chopper.

The sugar mill of Chinapatam is a slight improvement. Instead of the standing stump of a tree being used, which could only be done when a suitable tree grew on the desired spot, the mortar is carefully fashioned out of the trunk of a tree some 10 feet long, 8 feet of which is firmly embedded in the ground. The hollow, for two-thirds of the depth, is in the shape of an inverted trun-

* Rev. W. H. Brett's 'Indian Tribes of Guiana' contains a coloured plate representing Caribs crushing sugar-cane in this manner.

cated cone, the remaining third being cylindrical, with a hemispherical projection at the bottom, like the lower part of a common beer bottle. A forked branch of a tree is worked down to a beam or plank some 4 or 6 inches in thickness, and varying from near 18 inches in breadth at the single end to less than a foot at the forked ends, when, by-the-way, it has much the appearance of a monster boot-jack. This beam is placed horizontally with the hollow against the mortar, and the bullock-driver sits on the undivided end to which the cattle are attached, while the beam turns round the mortar like a screw-key which, if too large, would slip round a nut. The pestle is a piece of hard wood of the usual form, which is pressed down by a beam, one end of which is attached either directly over or near above the undivided end of the lower beam. There is a hollow on the under side of this upper beam immediately over the mortar, in which rests the top of the pestle, the other extremity being pulled downwards by cords attached to the forked ends. By tightening or slackening these cords the upper beam acts as a regulating lever to give the pestle more or less force. The whole arrangement when at rest has very much the appearance of a huge lime-squeezer.

The transition from the arrangement last described to the vertical wooden roller mill, now in use in other parts of India, was but natural. We find in this mill the same idea of a lever pressing upon the top of the pestle applied to another purpose, in the beam which is fixed to the top of the longer of the two rollers which projects above the framework in which they are placed. The other roller, which is only the height of the frame, is turned by the four spiral grooves and ridges at the upper end, being jammed against corresponding grooves and ridges on the long roller. The transmission of motion by means of the cog-wheels of modern times is thus seen to have had its origin, probably many centuries before the Christian era, among the ancient inhabitants of India.

To place two such cylinders of hard wood in a frame, horizontally instead of vertically, so that they could be turned by two men, one at each end, and could be easily moved from place to place, was the simplest way of meeting the requirements of those who had but little cane to squeeze. Its cheapness, however, was probably the greatest inducement to its adoption. Such mills are in common use near Calcutta. They are almost universally employed by the Chinese, amongst whom they are conveyed from place to place, along the rivers and canals in the sugar districts, by migratory sugar boilers. Being temporarily erected in some central spot, where the produce of several farms can be conveniently brought, the workmen are kept in constant employment until the canes near at hand are all cut, and another move becomes necessary.

We thus find in the records of the ancient arts of Hindostan roller mills for crushing cane, both vertical and horizontal, which are barely improved amongst the same people at the present day, and are exact prototypes of the machinery now in use.

The first mills used in more modern times were known as edge-mills, and are now chiefly used for crushing oil-seeds, apples in cider districts, and in tanneries. A large heavy wheel, generally of stone, was made to revolve vertically upon its edge in a small circular area, some 8 or 10 feet in diameter, by cattle or wind power. The pieces of cane were strewed in the concave path of the wheel, and the juice flowed away by a channel formed for the purpose. Père Lafitau relates the donation to the Convent of St. Benoit by William II., King of Sicily, of such a mill for crushing sugar-canes, along with its privileges, workmen, and dependencies, which remarkable gift bears the date 1166.*

In the next century we find mention of the use of vertical wooden rollers in Europe, the introduction of which is generally attributed to Gonzales de Velosa. In the fifteenth century their use crept to Madeira and the Brazils. Early in the century following, roller mills were established in Hayti and in other places, contemporaneously with the spread of cane cultivation. The old vertical wooden mill is still to be found in many places in the West Indies and elsewhere.

From wooden rollers to those of stone, and then of iron, the progression was unavoidable. Many examples of stone roller vertical mills are still in existence, while vertical mills with iron rollers are even now comparatively common. Ligon states that when he visited Barbados in 1647 the planters were ignorant of many things, and amongst others he mentions "the true way of covering their rollers with plates or bars of iron. This information, it appears, they obtained from Fernambuck (Pernambuco), in Brazil, whence they had gotten plants."

Cattle gave place subsequently to wind and water power, both of which are still largely used in remote districts. The use of steam has enabled boiling houses to be erected, and consequently estates to be established in situations where it had been impossible to do so previously. Its employment as the motive power in estates' boiling houses may now be said to be general, although it offers a method of economizing labour in many operations to which it has been seldom or never applied as yet, the advantages of which, even at the present day, remain to be estimated at their true value.

Within the last forty years mechanical engineers have brought the old model horizontal roller mill to the highest state of perfection. The first letters patent ever issued in England, in connection with sugar manufacture, were granted to "Willoughby, Francis, Lord; Hyde, Laurence; and De Marcato, David," for the "makeinge and frameinge of sugar mills;" and are dated and numbered A.D. 1663, February 4—No. 141. Mills have since been made of three, four, and five rollers; but those consisting of three rollers have been found to give the best results with the least expenditure of power. Since the above date, upwards of 100 patents have been taken out relating to machinery for extracting

* 'Histoire des Découvertes et Conquêtes des Portugais.'

the juice from the sugar-cane, all of which, with some dozen or so of exceptions, are merely adaptations of, or improvements in connection with, roller crushing mills.

The inspissation of the juice appears to have been carried on in India from the earliest times of which any account is discoverable. Although the mill was universally without shelter, the boiling apparatus, on the other hand, was invariably covered by a shed. The range consisted of a series of (generally) eleven earthen boiling pots, suspended between two parallel mud walls about 20 feet long, 2 feet high, and 18 inches apart, the interstices between the pots being filled in with clay. A flue was thus formed, at one end of which was a large circular iron pan, exactly like the present copper, under which was the fireplace—a hole dug in the ground. The iron pan served as the teache.

The arrangement just described has undergone no alteration or improvement up to the present day; neither has the process adopted, which is as follows: After the juice has been concentrated to the consistence of syrup—goor or jaggery, as it is termed—it is placed in pots and handed over by the ryot, or farmer, to the goldar, or sugar boiler. When it has to bear carriage a long distance it is further concentrated by the ryot, until it resembles an inferior description of concrete. By the goldar the pot extract is put into bags of coarse gunny or jute-cloth, which are hung over a number of large earthen vessels, and on water being sprinkled on the tops of the bags, the molasses drains away by displacement. The sugar from the bags is then mixed with water in a pan like a large copper, sunk in a cylindrical cavity in the ground, which serves as a fireplace. After being allowed to boil for a short time, an alkaline solution prepared from the ashes of the plantain stem is added, and subsequently some milk. The liquor is next strained through cotton, and the former process is repeated until a sufficient concentration has been attained. It is then poured into earthen pots with curved sides, large at the top and pointed at the bottom, where they are plugged with a plantain leaf and placed in a curing shed on a wooden grating at some little distance from the ground. Here they are allowed to drain into vessels placed underneath. A layer of moist leaves of the *Valisneria spiralis* is placed on the top, which after some time is removed, and, the crust being broken, fresh leaves are added, and the process is repeated until complete crystallization has taken place.

Gurh, or unrefined sugar, is the result of boiling the cane juice in shallow iron pans to the consistence of gum, when it is made up into round balls or cakes. In this form most of the people of India eat their sugar. The raw produce, which goes by the name of goor or jaggery, is made chiefly by a number of farmers acting in concert. The process is carried out in common by the association, but is specially deputed to some of their number, who confine themselves to this branch, the produce of each man's land being sent to the common factory. The goor is then handed over by the ryots to another distinct caste, the goldars, who make the solid sugar, some of whom again are sugar-boilers or refiners, and others

confectioners, who make candy, &c. The vital principle of division of labour is thus most strictly carried out, the whole manufacture involving at least the employment of two sections of one caste, and, where it is largely followed, two distinct castes and no less than five or six sub-classes, which implies its division into as many different branches.

The canes to be used for sugar and jaggery are taken direct from the field to the shed and a press. When about twenty chatties of juice have been obtained the boiling begins, and lasts for an hour. To each boiler of juice a *viss* of lime is added. When boiled the mixture is poured into an iron vessel, and after being stirred for a while is poured out again on a mat, on which the sugar dries and becomes hard. It is then broken up and packed for market in baskets of five maunds each.

The goor of the Sahitru districts in Sind varies in appearance and substance from that of other parts. It is remarkably hard, and requires some exertion to break it, and is at the same time of a very deep colour. This is doubtless owing to the nature of the sugar-cane, which is quite different from that of Southern India. It is a thin, cane-like plant, seldom much thicker than a small finger, very hard, and yielding little juice, so that to see the business of expressing the juice therefrom, one would imagine it scarcely worth the trouble. The flavour of the goor, however, is good. A superior kind of native spirit is made from this goor, which is very generally drunk by all classes without exception, although strictly forbidden in Mahomedan and Hindoo law. There are several kinds of it, which vary in price according to quality. The liquor is, however, intrinsically the same, the good or bad quality of it depending upon the quantity and variety of spices added to it.

Several varieties of sugar-cane are cultivated in India, such as the country cane, the original form of the species; the ribbon cane, with purple or yellow stripes along the stems; the Bourbon or Tahiti cane, a more elongated, stronger, more hairy, and very productive variety. *Saccharum violaceum*, Juss., the Batavian cane, is also considered to be a variety; but the larger *S. chinense*, Roxb., introduced from Canton in 1796 into the Botanic Gardens of Calcutta, may be a distinct species; it has a long, slender, erect panicle, while that of *S. officinarum* is hairy and spreading, with the ramifications alternate and more compound, not to mention other differences in the leaves and flowers.

In Assam sugar-cane is grown only to a small (but increasing) extent; it has been made the subject of some interesting experiments. The average weight of cane per acre is about 13 tons; the yield of the juice per 100 lbs. of cane ranges from 40 to 50 lbs., and the weight of goor, or raw sugar, from 7 to 10 lbs. It results that the sugar-cane of Assam yields only about half as much goor to the acre as the sugar-cane of Rohilkhand. In the North-West Provinces sugar-cane is cultivated chiefly in Saharanpur, Muzaffarnagar, Meerut, and Rohilkhand; though it requires both manure and irrigation, it is a remunerative crop. Great improvement has

recently been introduced into the process of crushing by the Bihia mill, patented by a European inventor. The area under cane in the North-West Provinces and Oudh was estimated to be over 1,067,000 acres in 1883; one-fifth of this is irrigated from Government canals. The maximum average produce of raw sugar (goor or jaggery) is estimated at about 30 cwts. per acre, which makes the total yearly production over the above area 32,000,000 cwts.; this, at 7s. 3½d. per cwt., equals £11,666,000. The Punjab, Madras, Bombay, Burma, and the native States, produce sugar in quantities of which it is difficult to get reliable figures; but supposing it to be half as much as that of the Gangetic Valley, the total would be 111,000,000 cwts., or 51 lbs. per head of the population. This does not include the produce of sugar from the palms, which is considerable in some parts of India. The exports of sugar are comparatively small. The following were the shipments in:—

Year.					Bengal.	Madras.
					Cwts.	Cwts.
1883	..	..	..	..	1,428,360	617,531
1884	..	..	..	..	1,777,157	685,742
1885	..	..	..	..	1,251,059	495,047
1886	..	..	..	..	1,331,103	506,062

INDIAN SUGAR—EXPORTS by LAND, CWTs.

Year.		Refined.	Unrefined.
1885-86		51,322	82,292
1886-87		101,046	89,924
1887-88		85,635	112,388

Exclusive of Bengal, there were, in 1887, the following areas under sugar-cane, viz.:—

	Acres.
Madras	46,624
Bombay	70,180
North-West Provinces	787,938
Oudh	142,484
Punjab	331,521
Central Provinces	47,833
Lower Burma	10,538
Assam	20,660
Bebar	5,402
	1,463,180

Sugar, or jaggery, was manufactured from the following areas in 1881-82:—

	Acres.
Sugar-canes	69,383
Cocoanut palms	5,706
Palmyras	24,884
Date palms	1,575
Sago palms	19

TOTAL SUGAR EXPORTS FROM INDIA.

		Cwts.			Cwts.
1867	..	221,006	1882	..	988,341
1877	..	1,144,467	1883	..	1,428,360
1878	..	908,212	1884	..	1,777,157
1879	..	368,546	1885	..	1,251,059
1880	..	373,242	1886	..	1,837,165
1881	..	644,531			

One of the chief obstacles to Indian grown sugars participating more largely in the demand for refined sugars is the defective system of expressing the juice, a system which causes vinous fermentation. The exports, chiefly of raw sugar, or goor, in cwts., have been as follows:—

Year.	Refined.	Unrefined.
	Cwts.	Cwts.
1880-81	18,915	515,259
1881-82	34,010	883,483
1882-83	111,274	1,207,424
1883-84	203,693	1,426,827
1884-85	55,323	1,015,596
1885-86	24,942	1,142,598
1886-87	33,340	953,066

The refined goes chiefly to Ceylon, the unrefined to the United Kingdom, Egypt, and other countries. The imports of refined sugar into India are becoming yearly more important, as the prejudice of the natives against this kind is removed; the average receipts now (chiefly at Bombay) being 1,600,000 cwts. yearly.

There are four joint-stock sugar manufacturing companies in India, one in Bombay, one in Bengal, one in the North-West Provinces, and one in the Punjab, viz., the Ahmedabad Sugar Candy Manufacturing Company, at Bombay; Carew and Company, Bengal; the North of India Sugar Refining and Distilling Company, and the Punjab Sugar Works Company.

Taking an average of five years, the price of Indian goor, or jaggery, is only a little over 7s. 3½d. per cwt., or less than half the price of colonial sugars. It is not to be expected that the necessarily domestic nature of the sugar industry of India can ever be improved to equal in quality of produce the careful scientific manufacture of the large sugar estates in the Colonies, with their costly machinery, and all recent improvements. Were the Indian ryot to step out of the rut to produce a better article, no one would give him a corresponding price for it.

Siam.—Next to rice, sugar is the largest article of export from Siam. Nachonyhaisi and Petno are the principal sugar districts; but it is also produced at Paklat, Bangpasoi, Chantibon, and Petchaburè in considerable quantities. The owners of the mills seldom cultivate the canes themselves, but purchase them standing in the fields from the growers, who have usually money advanced to them by the mill-owners at the commencement of the season, to enable them to plant on their ground, they in return being bound to sell all their canes at a fixed price to the person lending the

money, besides paying interest at the usual rate. The cultivation of the sugar-cane has greatly increased. It is mostly in the hands of the Chinese.

The extraction of the juice from the canes, and its manufacture into sugar, are carried on in a very primitive manner, without any of the modern improvements to obtain from the cane the largest possible quantity of a superior quality of sugar. The greatest quantity of sugar is made in the neighbourhood of Bangkok and the adjacent provinces, to where the tidal waters extend. Here irrigation in cases of drought may be carried on with the greatest convenience; and were there sufficient labouring hands to attend to its cultivation, ten times the quantity of sugar now produced might be raised in those localities to which the tidal waters extend, setting aside other places appropriate to its cultivation. With better machinery the manufacture might be greatly improved, for the culture is very careless.

White or clayed sugar, red unclayed, and yellow, are the three descriptions brought to market. The yellow is always deficient in grain. Most of it comes from up the country, and from Chantibon; it seems to be a peculiar description of sugar, and the Chinese manufacturers say they are unable to granulate it; it is usually pretty dry.

The best sugar is procurable in March and April; that which is made in the two following months is mostly from the second boiling, and is much lower in quality. The quantity produced ranges from 100,000 to 150,000 piculs, about 500 tons. The value of the sugar exported from Siam was, in 1880, £24,377, and in 1881, £26,000. Palm sugar is manufactured to a considerable amount at Pitchaburè, but it is all consumed in the country. This is not the same as the date sugar known in Europe.

A company called the Indo-Chinese Sugar Company was established here some years ago, which received a large grant of 3,000 acres from the Government at a yearly rental of 2s. 3d. per acre for the land under cultivation. Instead of the old hoe system of culture, steam ploughs and cultivators have been introduced, and large sugar mills on the newest principles erected.

China.—Although we have no data to guide us as to the sugar production of China and the local consumption, yet by going through the trade returns of the several ports, we glean some idea of the export trade as shown in the shipments for 1871, which were as follows:—

							Piculs.
Swatow, brown	..	..	..	..	..	..	461,420
" white	..	..	..	..	..	..	516,595
Canton ..	..	..	..	..	..	..	316,183
Shanghai ..	..	..	..	..	..	..	538,533
Amoy ..	..	..	..	..	..	..	194,406
Formosa, brown	..	..	..	..	..	..	560,510
" white	..	..	..	..	..	..	26,544
Chefoo ..	..	..	..	..	..	..	7,930
Total ..	..	..	..	..	..	..	<u>2,622,121</u>

Equal to about 3,277,651 cwts.

The imports of native sugar at the other ports for the same year were as follows:—

	Piculs.
Ningpo	87,000
Kiukiang, foreign	22,075
„ native	16,000
Chefoo	394,285
Tientsien	325,647
Newchang	80,042
Hankow	283,010
Chinkiang	285,149
Total	1,493,208

Or in round numbers about 1,866,500 cwts.

A considerable trade is done at Swatow in sugar for the supply of the northern part of the empire, there being 821,961 piculs of brown, and 995,937 of white exported in 1884, which shows a steady increase in the rate of production. A large sugar refinery, the property of the China Sugar Refining Company, of Hong Kong, has been erected here, and is now actively at work.

From Amoy the export of sugar for 1884 was 243,186 piculs, against 201,716 piculs in 1883.

From Takao in Formosa, 734,653 piculs of sugar were exported in 1883, and 897,110 piculs in 1884. Sugar plantations are numerous there.

The following have been the exports of sugar from China in piculs of 133 lbs.:—

	Piculs.		Piculs.
1876	1,263,444	1882	1,061,760
1877	1,275,656	1883	1,373,169
1878	585,246	1884	1,571,106
1879	726,834	1885	827,236
1880	1,238,194	1886	612,478
1881	957,564		

It requires ten months, from the time of planting, before the crop is matured and ready for harvesting. From the roots of the crop being well fertilised with the oil-bean cake in a semi-liquid form, a second crop is produced; even a third is sometimes secured from ratoons. If the soil is not sufficiently fertile for a third crop, the roots are removed, the land cultivated and manured as for the first crop, and cuttings are planted every two years.

Two distinct kinds of cane are grown in China, one being of a dark purple colour; this is better for sugar than the other, which is green and quite tender. The latter is principally sold in pieces about 8 inches to 10 inches in length to the natives, who eat it in its raw state.

Three kinds of sugar are manufactured, viz., rock candy, green sugar, and clayed sugar.

The Chinese method of pressing sugar is most rude. The cane is passed between two perpendicular granite cylinders; one, being turned by oxen, gives a motion to the others by means of cogs cut

on the granite, and shod with hard wood. The juice is thus expelled, and runs through a channel cut for that purpose into a large wooden tub, from which it is removed to the boiling hut closely adjoining. These cylinders are not at all firmly fixed, depending altogether upon their weight to keep them in position. An improved cane-mill was imported by an English firm, but the natives refused to try it.

Cochin China.—The sugar-cane is largely cultivated here (about 22,000 acres) by the natives for their own use. There are great numbers of sugar houses, producing various kinds of sugar, according to the nature of the soil and the modes of culture and working. There are four varieties of sugar-cane grown, the white, red, green, and the red and white; but the first of these gives the best results in the hands of the natives. The sugar obtained from it is tolerably white. A good deal is also made from the red cane, but in consequence of the imperfections in the mode of manufacture, the sugar is almost black. The canes are planted about the month of January, after the soil has been just turned over once, and on good lands the first crop is obtained in twelve months. During the two following years, without any more labour, they get further crops of cane by ratoons. The cane, when cut, is crushed in rough stone mills, and the juice is received in holes in the ground, from which it is taken to be evaporated. Fresh sugar-cane is sold in all the markets, at an exceedingly low price, as a sweetmeat, of which the lower orders of the Annamites and the children are excessively fond.

Japan.—The provinces where sugar is mostly grown are Isé, Owarii, Totomi, Suruga, Aki, Ku, Awa, Sanuki, Tosa, Hizin, and Satsuma. Sanuki has the reputation of producing the best kind if white sugar, and Satsuma the better quality of the darker description. Consul Robertson thus describes the mode of culture:—"At the commencement of the cold weather, small bundles of sugar-cane roots are planted in rows, stem down and roots upwards, on a slope of about 45 degrees. The following spring they are taken up, and about 2 inches of cane, both above and below the joint having been cut off, they are planted out in the proportion of about 900 lbs. weight of cane to one quarter of an acre of ground. The soil is well looked after in the spring, and a quantity of small holes dug here and there. Into these the lees of oil are poured, and they are then filled up with earth, in which the cane slips are now planted out; that is, as soon as the cane slips show signs of budding, or of having taken root. When planted, a little liquid manure is applied. After the lapse of fifteen days, the slips or roots will have attained to a growth of about 7 or 8 inches. At this stage fish manure, mixed with the lees of oil, is applied. In droughty seasons the ground is also watered. There are three kinds of insects which do much harm to the sugar-cane in Japan, and against the ravages of which some precaution has to be taken.

During the winter the canes which have attained the highest growth are either broken off just above the roots, or are cut with a

sickle. The canes are then stripped of their leaves, and are made up in bundles, each of about 80 lbs. weight. A quarter of an acre of ground will produce about 10,800 lbs. of cane, and this quantity of cane will turn out from 6 to 7 piculs (798 to 930 lbs.) of sugar. The sheds in which the cane is crushed are generally about 24 feet square, and in each there are three crushers worked by oxen. The teeth of the crushers are kept constantly fed with cane, about 4 or 5 feet being inserted at a time. A workman stands behind, on the watch for any canes that may slip through the crusher without being caught in the action of the mill, and canes that have so passed are handed to a third man, who feeds the mill from the opposite side.

The mill having a reverse action, it thus results that no one cane is lost. The cane-juice is now removed to a separate place, in quantities of about 200 lbs. weight at a time, and the mill is cleansed after each such removal. The syrup goes through no less than four refining processes, and is afterwards removed to where it is to be made into sugar. The working up of about 2,220 lbs. weight of canes is considered a fair day's work. As regards the further process with the syrup, about 133 lbs. weight are poured into two tubs containing half of the above quantity. Fires are then lit under the boilers, and the contents of one tub poured into the boiler. A small quantity of lime is then mixed with the syrup, which is skimmed when at boiling-point. The clearness of syrup will be the test of its having been sufficiently boiled. If the syrup is thick, or in any way impure, it shows that either too much or too little lime has been put in. The syrup is now placed in a tub, in which it is allowed to settle, fresh syrup is again poured into the boilers, and boiling goes on as before. As soon as the syrup is once more at boiling-point, that which has been already boiled is poured in and mixed with it, the white froth being skimmed off and placed in an empty tub. The syrup is now divided between the two boilers, and allowed to simmer for about two hours, being constantly skimmed during this time. In order to ascertain the amount of boiling which the syrup has undergone, a bamboo is inserted, and on withdrawal the drops are allowed to fall into a saucer containing water. If the drops congeal rapidly, the fires are at once withdrawn from the boilers, the syrup promptly poured into coolers, arranged in sets of four, and constantly stirred. So soon as it has sufficiently cooled, it is poured into tubs, one man attending to each tub. To make the very best quality of sugar, a picul of ordinary sugar is divided into nine parts, and each is wrapped in a hamper cloth; they are then placed in receptacles, pressed down with heavy weights, and are thus sweated for one night. On the following morning the sugar thus sweated is placed on a table and kneaded for about two hours, after which it is again wrapped in cloths and the same process gone through for three successive nights and days. On the fourth day it is placed in clean receptacles, and is now termed first quality sugar.

To obtain a superfine quality, the sweating and kneading is

gone through for an extra day. A picul (133 lbs.) of ordinary sugar will thus be made to yield about 50 lbs. of first quality sugar; the remaining 80 lbs. are, of course, not wasted, but from it are obtained about 40 lbs. of a sugar known to Japanese under a particular name, and the residue also finds its way to market. Second quality sugar is known as "jui-mai," and is made by sweating a certain quantity of coarse sugar.

Sugar is generally known to the Japanese under three headings, white, black, and candied; but the two former are again known under a variety of names. A good deal of black sugar is produced in the Loochoos, in Sakurajuna, Araki, Hanaoka, and Jaramidzer.

Any marked difference as to good or inferior kinds of black sugar depends on the quality of the canes and the skill of the workmen, but the above-mentioned places have always well sustained a reputation for providing the best sugars.

Sugar-candy is made by boiling down a certain quantity of best quality sugar, and adding the white of egg. Split pieces of young bamboo, about an inch in length, are then put into the syrup, which crystallizes around them. A good deal of sugar candy is made in Osaka.

Either Japan sugar cannot compete with that produced in China, or the supply is not equal to the demand, for the import of China sugar is always an important item in the trade returns in Japan; they have been as follows:—

				Cwts.					Cwts.
1882	::	::	::	941,000	|	1884	::	::	1,400,000
1883	::	::	::	1,000,000	|	1885	::	::	1,221,000

Borneo.—The sugar-cane is grown by the natives sufficient for their own consumption.

In 1863 an English company was started, and 200 acres planted with cane, and sugar and rum are now articles of export to Singapore.

Owing to the heavy fall in price, consequent on the over-production of beetroot sugar, cane-growing has been but little tried by European planters in North Borneo as yet, and nearly all that has been grown has been sold in the local markets for chewing purposes. Some few experiments in sugar-making, however, have shown that the cane contains an unusually large percentage of saccharine matter. Of the canes tried, Sumbelowan (yellow, streaked with green) gave the best results, yielding syrup of a density of 10·5 Beaumé; Tubu Puteh, or Lahinia, as it is called in Australia, giving a result of 9·5 per cent.

There is now reasonable expectation that some recovery in price may be looked for, but it is not therefore to be supposed that prices will ever quite regain their former level, and it is clear that only those places that are possessed of the greatest advantages in the way of cheap labour, cheap land, suitable soil, favourable climate, and great facilities for transport and export, will ever be able to successfully compete against the lower prices caused by the large Continental production of beetroot sugar. All these advantages

are possessed in an eminent degree by British North Borneo. There seems little doubt but that this settlement, when sugar-making is undertaken seriously, will soon take the lead as one of the largest Eastern sugar-producing countries.

Mauritius.—This is now one of the principal British sugar-growing colonies. About 1750 the sugar-cane was first introduced into the Mauritius. In the commencement it made but little progress, but as the cane began to be better appreciated its cultivation increased with marvellous rapidity, until it has now become the chief, almost exclusive, resource of the island. The white cane which is indigenous to the islands of the Pacific is said to have been first planted in the Mauritius, but the disease with which this variety had been attacked considerably restricted in after years its cultivation. Of twenty varieties which have been introduced at different periods, the following six are said to be the most commonly cultivated in the island :—

The white cane of Otaheite.

The bamboo cane of Batavia.

The Guinghan, or violet-striped cane.

The Bellouguet, or purple Java cane.

The Pinang cane.

The Diard cane, with which the white Bellouguet is generally confounded.

The last is a recent importation from Batavia. It is a hardy plant, thrives well with moderate care and attention, produces a greater quantity of stems than the white cane, but does not hold in the ground so well, which is a disadvantage in a climate subject to high winds and hurricanes. It yields well both in respect of the number of canes and the quantity of juice, which is superior in quality to that of most of the other species.

The Pinang cane is a very fine species, producing, after the Otaheite, the longest and thickest canes, but it does not, like the Diard and some other species, give so many stems. It is a tender plant, and requires a great deal of care.

There are two species of Bellouguet, the one white, the other red. Both species, like the Diard, give a great many stools and require a great deal of room to allow for spreading, without which the stems grow meagre; but planted wide apart and carefully tended this species will produce well. The white is preferred to the red, on account of the superior quality of the sugar made from it. The red gives a sap strongly coloured. It is very difficult to remove this colouring matter, which injures the quality of the sugar. Both species require sheltered situations to come to perfection. Their roots growing laterally and horizontally, they have no hold in the ground. The great quantity of stems they produce offers a larger surface to the action of a high wind than the roots are calculated to bear; they are therefore easily uprooted, and considerable loss is the consequence.

The Bamboo cane is the hardest of all the species; but it is not much admired, owing to its partaking partly of the nature of

the reed from which it derives its name. The stem is hard and dry; but in exposed situations and in marshy ground it grows well and produces a fair return. It requires less attention and stands drought very well. The quality of the sugar made from the juice of this cane is inferior.

There are many other species cultivated; but none are of sufficient importance to require separate mention. In good soil, canes may, with attention and suitable manure, be cut for six or seven seasons running without its being requisite to replant. This is considered the longest time canes will yield a profitable return in the best soils, in the lower portion of the district. In the higher parts, the cane plant is never expected to last more than three seasons, and only two on poor soils, or where stones are common.

Mr. J. Horne, the sub-director of the Royal Botanical Gardens, Mauritius, in a Report in 1875, stated that the introduction and propagation of new varieties of the sugar-cane had been given up, for the present at least. It had been of good service to the colony, and, instead of the sugar crops depending upon the health of three or four varieties of the sugar-cane, the planters had now a choice of nearly one hundred. A great matter is the choice of healthy cane tops for planting. None but tops of the most vigorous and healthiest canes should be selected. Through neglect of this, the canes deteriorate, till at last whole fields come to be planted with cane tops which are unhealthy and positively diseased. The Sandwich Islands, and perhaps New Guinea, are the places to which the planters of Mauritius will have to look for new varieties, more prolific, hardy, and healthy than those they now possess. One variety, called "Puollæ," has been known to yield an average, per acre, of 12,000 lbs. = 6 hhds. of No. 16 sugar, on an extent of 30 acres of good land, which had been irrigated. It is reported to be hardy and to grow freely, in its native country, at an elevation of 2000 feet above the sea.

The principal improvements made in the manufacture are the vacuum pan and the centrifugal drying machines, of which there are many at work, particularly in the higher parts of the district, where, from the nature of the climate, they are indispensable. The advantages of both are undeniably great. Samples of sugar made with the two improvements combined show that sugar can be made directly from the cane juice which will bear comparison with the best refined sugars; the crystals are larger, better defined, and when "clairced" are perfectly white, even without the aid of animal charcoal. The superiority of these methods over all others is incontestable. The sugar far exceeds in quality sugar made in any other way: it is made, dried, and is ready for shipment the day after the operation is commenced. All the inconveniences of the old system, which required at least fifteen days to perform what is now done in forty-eight hours, have vanished. The syrup, which formerly remained in large tanks till it was fermented and unfit for any other purpose than to make rum, is now converted

into sugar immediately, and almost all the crystallizable portion at once obtained.

The improvement next in importance is the process of making sugar called Wetzell's, from the name of the inventor. The operation is not so perfectly performed as in the vacuum pan. The quality of the sugar is consequently inferior; but still it is a great improvement on the old method,—the apparatus is less expensive, can be made in the colony, and with the aid of “turbines” sugar of fine quality is produced. The crystals are, however, smaller and not so clear and well defined as in vacuum-pan sugar. These machines are employed on many estates, and the result obtained is satisfactory.

The great superiority of the Mauritius sugar arises from the manufacture by Dr. Icery's process of purification by monosulphite of lime without filtration by animal charcoal. The syrups remaining from the turbinage of sugar when treated with monosulphite of lime give most advantageous results. Under the influence of this agent, syrups become purified, decolorized, and crystallized with remarkable facility. Manufactured by this process, syrup sugars have a perfect grain and fine colour, not entirely due to the direct influence of the substance employed, but to the preparation to which the veson or juice has already been submitted, and the absence in the syrup of those foreign soluble matters which are the principal obstacles to the crystallization of the sugars of the second boiling.

In Mauritius by the processes used, all things being equal, the proportion of sugar from a barrel of cane juice (which weighs from 530 to 544 lbs.) will depend not only on the relative richness of the liquid, but also on the various circumstances in which the manufacture may be placed. The average yield may be taken at 95 lbs. of sugar per barrel of juice, and the average yield of sugar per acre ranges from 3500 lbs. to 5500 lbs.

Dr. Icery made numerous analyses upon the various species of mature canes cultivated in this island, but grown in localities differing in soil and temperature. The result of his observations was the following average percentage of the composition of the juice:—

Water	..	..	..	..	..	..	..	81·00
Sugar	..	..	..	..	..	..	..	18·36
Mineral salts	..	..	..	..	..	..	..	0·29
Organic substances	..	..	..	..	..	..	..	0·35
Total	..	..	..	..	..	..	..	100·00

Cane sugar ($C_{12}H_{11}O_{11}$) is distinguished from all other kinds by the property it has of crystallizing in large rhomboidal prisms, and the facility with which it is possible to obtain it in this state, when dissolved in water.

There is a large consumption of Mauritius sugar in Australia and India, where the coarser quality is principally sent.

The number of sugar estates and their acreage in 1876 were:—

District.	Sugar Estates.	Acres Cultivated.
Pamplemouses	29	11,414
Rivière du Rempart	22	12,250
Flacq	38	26,851
Grand Port	34	22,548
Black River	11	4,940
Plaines Wilhenis	19	12,750
Mokha	17	11,133
Savanne	29	20,290

The following figures give the exports from Mauritius :—

Year.	Sugar.	Rum.
	Cwts.	Gallons.
1877	2,763,477	1,000,534
1878	2,613,798	982,614
1879	2,112,838	849,321
1880	2,208,604	689,323
1881	2,212,228	845,139
1882	2,366,590	923,770
1883	2,311,420	552,243
1884	2,503,047	706,988
1885	2,294,506	825,256
1886	2,360,220	758,480
	23,746,728	
Average	2,374,672	

In 1867 the exports were 100,000 tons, now they average nearly 120,000 tons.

Réunion.—There are about 80,700 acres under cane in this island, and sixty plantations, all with steam-worked mills, the average production being about 34,000 tons. The yield in 1885 was 30,347,421 kilogrammes of raw sugar, and 1,308,811 kilogrammes of clayed sugar, and 4,066,000 kilogrammes of molasses. There are thirty-three distilleries, which made 2,897,836 kilogrammes of rum.

Mayotte.—In this French African Island there are 5000 acres under sugar-cane, and here and at Nosse-Bé about 3322 tons are produced. There are sixteen plantations, of which twelve possess steam mills.

St. Marie and Madagascar also produce about 500 tons.

Straits Settlements.—In Province Wellesley considerable improvements have been made in agricultural operations of late years on the estates of European planters; the Chinese are also entering largely into the cultivation of sugar, and are obtaining steam machinery to replace the old cattle mills, which they have hitherto employed in grinding the canes.

Philippines.—The sugar-cane is cultivated in Negros, Panay, Cebu, Luzon, and in nearly every part of the Archipelago; the yellow variety being generally raised in the province of Pampanga

(Luzon), and the purple in Negros and Panay. The shoots are planted in the month of February, and the crops are cut in the January following. The yield of raw sugar from cane planted in an indifferent soil is about 12 piculs (15 cwts.) per acre; in the best soils about 40 piculs, the average therefore being about 20 piculs. The best quality is from Pampanga, and the worst from Taal or Batangas. The native apparatus for crushing the cane, which consists of two stone cylinders with wooden teeth, is now being superseded in many places by iron rollers from England. Steam sugar mills have also been erected on several estates. It is impossible to compute the total production, as there are no statistics on the subject, and we can only get at a few particulars of the shipments from different ports.

The exports of sugar from Iloilo, island of Panay, were in

				Tons.					Tons.
1855	..	..	..	750	1861	..	..	..	4,598
1856	..	..	..	850	1862	..	..	..	12,586
1857	..	..	..	1,800	1863	..	..	..	15,677
1858	..	..	..	1,290	1883	..	..	..	93,750
1859	..	..	..	5,427	1886	..	..	..	198,185
1860	..	..	..	7,048					

Previously to the year 1867 the greater part of the sugar made in the Philippines was forwarded to England; but a large quantity is now taken by the United States.

Shipments of sugar from the whole of the Archipelago:—

				Piculs.					Piculs.
1862	..	..	..	1,302,484	1869	..	..	..	1,101,500
1863	..	..	..	1,172,050	1870	..	..	..	1,256,582
1864	..	..	..	1,035,027	1872	..	..	..	1,530,641
1865	..	..	..	896,832	1873	..	..	..	1,429,322
1866	..	..	..	855,280	1874	..	..	..	1,653,128
1867	..	..	..	1,015,887	1875	..	..	..	2,017,361
1868	..	..	..	1,180,567					

The Philippines in 1879 exported 135,698 tons of sugar; now the shipments exceed 200,000 tons. The annual crop of Iloilo now exceeds 1,250,000 cwts. The island of Negros contributes three-fourths of the sugar shipped from Iloilo, the quality of which is improving every year. Cebu also exports sugar.

Java.—The sugar culture in Java is one of the chief supports of the Treasury. The principal points of the contracts which formerly existed were that the Government assisted the planter in making ready his fields, in planting and cutting the canes, and sometimes in bringing the canes to the mill; while, in return for this assistance, he ceded to the Government a certain portion of his produce at a fixed price. It was found, however, that these conditions did not suit the present times, and in 1870 a measure was introduced and passed by the Chamber, in which several important modifications were made. The chief was that, instead of as hitherto paying Government in kind, planters could pay

Government a certain sum of money in proportion to the product and extent of their estates. The consequence of this was that in 1872 a very much larger quantity of sugar than heretofore passed through the hands of the commercial community. In 1863 the exports were 130,000 tons; in 1873 the production was estimated at 2,500,000 piculs. It has since nearly trebled.

JAVA SUGAR CROP.

			Piculs.				Piculs.
1881	..	..	4,606,780	1884	..	..	6,493,000
1882	..	..	4,809,322	1885	..	..	6,260,000
1883	..	..	5,348,867	1886	..	..	6,145,000

China takes about 1,000,000 piculs of this.

The exports of Java sugar have been as follows:—

			Tons.				Tons.
1875	..	..	207,187	1881	..	..	209,831
1876	..	..	198,949	1882	..	..	332,921
1877	..	..	232,355	1883	..	..	307,897
1878	..	..	230,971	1884	..	..	359,036
1879	..	..	195,657	1885	..	..	420,393
1880	..	..	234,122				

The Netherlands Indian Agricultural Company had in working, in 1886, thirty-one sugar factories, which produced 954,844 piculs of sugar, and 9,544 piculs of sack sugar.

The following shows the comparative yield of sugar in the different residencies, in bouws of $1\frac{3}{4}$ acres, and in piculs:—

Residencies.	1885.		1886.	
	Bouws Planted.	Yield per Bouw.	Bouws Planted.	Yield per Bouw.
Cheribon	947	$50\frac{1}{2}$	926	$80\frac{1}{2}$
Tigah	2,097	$97\frac{1}{4}$	2,117	77
Japan	603	$74\frac{1}{6}$	603	$94\frac{6}{10}$
Madioen	507	$79\frac{1}{3}$	500	78
Kedirie	1,776	$79\frac{5}{6}$	1,927	$83\frac{1}{4}$
Soerabaya	3,259	$88\frac{3}{4}$	3,372	$90\frac{6}{10}$
Pasaroean	520	$95\frac{2}{5}$	569	90
Probolingó	1,356	92	1,371	$90\frac{1}{2}$
	11,067	$85\frac{1}{3}$	11,385	$85\frac{6}{10}$

The exports from Netherlands India of sugar on private account were in

				Tons.
1875	..	..	..	209,738
1880	..	..	..	222,242
1885	..	..	..	420,393

SUGAR EXPORTED from NETHERLANDS INDIA, in KILOGRAMMES.

Year.	Java and Madura.	Other Parts.
1872	194,806,209	82,173
1873	195,702,548	264,663
1874	199,109,568	6,256
1875	209,719,408	19,326
1876	221,164,475	41,952
1877	223,468,279	43,021
1878	236,292,842	834,650
1879	191,434,000	35,607
1880	222,222,574	19,917

The following table shows the destination of the Java sugar exported in 1885, in kilogrammes:—

Holland	25,057,000
Suez Canal, for orders	128,747,000
England	130,592,000
France	22,404,000
Turkey	556,000
Italy	3,239,000
Spain	13,239,000
Portugal	31,310,000
America	1,681,000
Egypt	17,461,000
British India	909,000
Singapore	14,292,000
Hong-kong	11,215,000
China	6,308,000
Australia	13,185,000
	<u>420,367,000</u>

Queensland.—The sugar industry rose in 1878 to 16,000 acres, and there were 68 mills at work, nearly one-half in the Southern district, 17 in the Central, 16 in the Mackay district, and two in the Cardwell district. The produce in that year was 270,510 cwts. It has now reached over 56,000 tons. The exports alone are shown to have been in 1885, 749,273 cwts., and in 1886, 880,262 cwts. Considerable quantities of sugar are shipped to the neighbouring colonies, where it commands a good price. Queensland, besides providing for its own consumption, is able to supply Australasia with an article of superior description. The sugar plantations in Queensland continue to give promise of very satisfactory returns.

The suitability of the soil in many parts of the colony, and its tropical and semi-tropical climate, directed the attention of the colonists at an early period of its history to the growth of sugar-cane as a promising industry. As far back as 1862, an experimental patch of 20 acres is noticed in the official records, planted in the neighbourhood of Brisbane. The experiment gave good hope of success, and the attention of cultivators was attracted by it. Regular plantations were formed in the Brisbane district, and

near Maryborough, which in 1865 returned 316 and 112 acres respectively under cane. Experimental patches were tried elsewhere, some in places where the industry has not since taken root. But in that year 20 acres were tried near Mackay, a locality which to-day is the main centre of sugar cultivation. The industry showed signs of vitality, and the Legislature encouraged it by granting land on easy terms to sugar cultivators. In the year 1866 sugar mills first appear in the official returns; two in the Brisbane district, one on the Mary River. As a consequence there is an actual recorded production in the statistics of 1867, to the amount of 338 tons of sugar and 13,509 gallons of rum. The cautious hesitation with which the new industry was at first regarded began now to be thrown aside. Planters sought for cheap coloured labourers, it being considered that the constant petty work which had to be performed in the sweltering heat that prevails between the tall rows of cane would be too trying for the constitution of Europeans. South Sea Islanders were accordingly brought to the colony, and the trade in kanaka "recruits," as they are called, became so considerable that the Legislature passed an enactment to check the abuses which had sprung up in connection with it.

In the year 1868 the recorded production of the plantations amounted to 619 tons of sugar and 35,599 gallons of rum; in 1869, 5165 acres of land were put under cane. By 1871 the production of sugar had reached 3762 tons, of rum 112,979 gallons, and the staple was exported to the value of £16,262. It was also recorded that 55 sugar mills were in existence. The progress was rapid. In the next year, 1872, ten more mills were added to the number, the production of sugar was 6266 tons, of rum 161,473 gallons, and the export had reached a value of £36,803. But the industry was about to receive a check. The hesitation with which its first introduction had been received yielded to a headlong rush of cultivators eager to share the fortune it seemed to promise. Farmers in some districts abandoned every other kind of cultivation and planted cane right up to the walls of their cottages. On the Mary particularly, the settlers threw themselves entirely into the new cultivation. It appeared to them to be exempt from the limitations that bound every other kind of agriculture. The cane was planted in newly-cleared land, by making holes in the unbroken surface and laying the "sets" in them to grow. Very little weeding was done, and the cane, left almost to itself, grew luxuriantly and apparently free from any disease. And while the small settlers went on in apparent confidence that the ordinary laws of nature would be suspended in favour of sugar growers, the planters and millowners proceeded in many cases on a not much wiser plan. Money was borrowed for the purchase of expensive plant, on a scale and on terms which no industry, however profitable, would justify. The money was expended also with very little knowledge; almost any man who had lived on a plantation in the older sugar-producing colonies obtained ready employment from the Queensland sugar growers, and was entrusted with the direction

of work that sometimes involved large expenditure. In reality it was a continuation of the experiment of sugar growing on a large scale and in a costly manner. The relations between millowners, who in all cases had plantations of their own, and the neighbouring farmers who looked to them for the disposal of their cane, became also very unsatisfactory. Both parties had rushed into the enterprise with a vague confidence that it would come out right, and it failed to do so. Quarrels and misunderstandings arose between the two, and there appeared to be a strong probability of a reaction. And to add to the difficulties of cane growers, a new disease made its appearance among the cane. Up to that time one variety, the Bourbon, had mainly been grown. It was a large, rather soft cane, that grew freely, and yielded great quantities of juice. But, exposed in the southern districts to the rather violent variations of a sub-tropical climate, and cultivated in the rough-and-ready manner described, it succumbed in many places to the attack of a kind of rust which entirely puzzled the cane growers and defied any attempt at cure.

The lesson was a sharp one, but the industry had become too firmly rooted to be overthrown. A number of speculative men who had overstrained their means in order to embark in it had to succumb, but cane growers found a way out of their difficulties. The practical experience gained during the years in which cane growing had actually been carried on in Queensland served to put the industry on a sound footing. There were plenty of men by that time who had learned the business in the actual field, and sugar mill, and on Queensland soil. The cultivation of the cane was better understood, and although the introduction of new varieties of it did not actually banish rust from the fields, it at least served to reduce it from an evil of the first magnitude to the rank of one of those minor difficulties which all cultivators have to encounter and overcome. Continual progress was made in the art of manufacturing sugar, till it equalled in appearance and value the best production of Mauritius and the West Indies. The progress of the industry has since been very satisfactory. In 1877 the number of acres actually put under crop was 15,220, and there were 12,243 tons of sugar and 196,662 gallons of rum manufactured. The production, it must be remembered, is confined to the higher grades of sugar, so that the average value of the product is high. In the year mentioned the value of sugar exported was £180,668. Of that amount the value of raw sugar—almost entirely of the highest grades—was £133,297, that of refined sugar £47,371. In 1878, a year of general drought, the export of sugar was valued at £119,018 and of rum £6208; in 1879 the value was £275,769 and £10,453. To these values must of course be added the amount consumed in the colony itself. The export of sugar for the years 1878 and 1879 averaged a value of a little over £12,000. In a carefully compiled report on the sugar industry of Queensland published by Mr. H. Ling Roth, he calculates the average local consumption of sugar and molasses at 92·13 lbs. per head of population, which was in 1879 about 220,000 souls. In the same work the crop of 1879 was estimated at about 18,200 tons

of sugar, and the probable output for the year 1880 at about 21,000 tons. The sugar industry of the colony is now firmly established. Its main centres are the Pioneer River, of which the port is Mackay, the Mary River with Maryborough as the port, and the rivers emptying into Moreton Bay. Of these the relative importance can be seen by the following division of the 1879 crops, which is given in the work already quoted at 9500 tons for Mackay, 5750 tons for Maryborough, and 2200 tons for Brisbane. Sugar is also grown on the Herbert River near Cardwell, and the yield is estimated at about 750 tons. The industry is about to be established on the Lower Burnett near Bundaberg. But it is in the far north that the most promising development of sugar cultivation seems likely to take place, on a splendid piece of country on the Johnstone River, near Mourilyan Harbour, north of Cardwell. It is calculated that in this locality there are 300,000 acres of good sugar land watered by several navigable rivers, and near to an excellent harbour. Cane is being grown on a small scale near Cairns, and is found to thrive. But the sugar lands on the Queensland coast must amount to many million acres. Even in the established centres of the industry only a fraction of the available soil has yet been broken up for cane. At Mackay, where the greatest progress has been made, there are only about 12,000 acres actually cultivated, and it is estimated that there are at least 70,000 acres of good sugar land untouched. Not only is a particular kind of soil needed, but many other conditions must be present before a settler can profitably grow sugar-cane. No apparatus has yet been brought into actual use which gives satisfactory results on a small scale, and extensive sugar factories can only be erected by settlers having the command of a good deal of capital. Cane also is a bulky crop, and cannot be profitably carted any great distance to a mill. Its cultivation, therefore, was at first confined to the banks of rivers where punts could ply between the mills and the cane fields. The difficulty of carriage is now being overcome by the use of tramways, but they also are expensive works. In short, cane growing has hitherto been an industry in which only capitalists have been able to engage with a hope of profit. Even under this restriction it has made, and is making, great progress.

Wherever the cane has been planted it has been successful, no matter whether in the colder latitudes of the South, or the dry regions of the Burdskin, or the rainy zones of the Tropics. The energy and skill of the colonist has been such that climatic difficulties were in each of these localities overcome, and a first-class sugar manufactured. The conclusion, therefore, is that the sugar-cane is a plant pre-eminently suitable for culture in this colony. It is to be noted that in the South the system in vogue has been so shaped that it embraces small-sized mills with peasant proprietorship, as befits the closer settlement by a class of German farmers, the greater abundance of European labour, and the cooler climate; that in the middle districts, where there is still a close settlement and a moderately cool climate, the same principle of farm cultivation is in practice; but that the manufacturing is undertaken by refineries of gigantic size and capabilities, whose

underground pipes are as an arterial system drawing the life-giving cane juice from the widely-separated farms. But that, as soon as the tropical line is crossed, the development of the industry has only been effected by a system of large estates, owned by capitalists who have spent freely their tens and tens of thousands of pounds before gaining any returns; and that attached to each of these mills is a large area of cane, the cultivation of which is only carried out by the employment of hundreds of South Sea Islanders as labourers. The suitability of this system of working for the tropical regions is evidenced by the fact that every establishment started, from Mackay northwards to Cooktown, has been founded and carried on to success on these lines.

The whole coast-line from the New South Wales boundary to Cooktown, a distance of nearly 1300 miles, is dotted at intervals of from 50 to 100 miles, according as there are creeks and rivers, with centres of this industry—centres which, but for the check owing to the fall in price of sugar and the uncertainty of a due labour supply, would have spread until hundreds of thousands of acres would have been under waving sugar-cane.

In 1884 there were 157 mills at work, producing 34,148 tons of sugar and 144,000 gallons of rum, and there were over 4,000,000 gallons of molasses as the by-product of the sugar-cane. 43,500 acres were actually under culture with the cane.

The processes in use for obtaining the largest amount of sugar from the juice, Mr. Roth tells us, are manifold, such as the Ehmann and Bernard process, and common lime process. There are 16 mills provided with Dr. Icery's monosulphite of lime apparatus; this process appears to succeed well with open pan sugars, but vacuum pan owners do not appear to be successful in its application. One mill makes use of an adaptation of the above, namely, monosulphite of magnesia; one uses bag filters, and one applies Eathorne Gill's galvanic apparatus. A mill at Mackay makes use of animal charcoal. Fryer's concretor is in use on one plantation, and at Yangarie Refinery Boivin and Loiseau's sucrate of hydrocarbonate of lime process is in use. Only one mill makes use of a cane-juice heater. There are 15 vacuum pans in the colony. The sugars are all centrifugated.

The average yield per acre in Queensland is about 25 per cent. As the density in Queensland varies from $7\frac{1}{2}^{\circ}$ to over 12° Beaumé, one may for the future expect a higher yield than hitherto.

The following may be taken as the average yield per acre in various countries:

		Lbs.
Demerara	.. .. .	4,480
Louisiana	.. .. .	1,200
Mauritius	.. .. .	3,500 to 5,500
Jamaica	.. .. .	1,344
Philippines	.. .. .	1,680
India	.. .. .	896
Brazil	.. .. .	2,800
Java	.. .. .	about 3,360
Queensland	.. .. .	2,800

England has always been considered the greatest consumer of sugar, her consumption in 1883 and 1884 being from 71 to 72 lbs. per head, but in the last two years this has dropped to 70 and 66 lbs.; but Australasia a few years ago consumed $78\frac{3}{4}$ lbs. per head; indeed, Queensland consumed over 92 lbs. per head, and in Victoria, in 1886, the imports over exports show an annual consumption of about 94 lbs.

The varieties of cane grown in Queensland are the black Cheribon, the Chigaco, a small yellow cane (name uncertain), a hairless variety, leaf with smooth edges; the violet cane, ribbon cane, and bamboo cane.

In *New South Wales* in 1872 there were 1994 acres under sugar-cane, which yielded 25,000 cwts., and 2399 acres unproductive. The yield of sugar in 1868 was 30,000 cwts.

In the year ending April 1st, 1883, there were 67,021 cwts. of sugar-cane grown in the Richmond River district, and 100,391 cwts. of sugar produced at the mills in the Clarence River district.

In 1885 there were 9583 acres of cane productive in the colony, and 6838 acres unproductive; 4,786,947 cwts. of cane were grown, and 369,280 cwts. of sugar produced at the mills. Of these there were 83 worked by steam and 19 by cattle; 622,601 gallons of molasses were produced, and 193,343 proof gallons of rum distilled. There were four sugar refineries in the colony, which turned out 380,550 cwts. of sugar.

Victoria.—The sugar-cane having been successfully grown in Spain and other countries on the Mediterranean Sea, Baron Mueller remarks that it is worthy of further trial whether in the warmest parts of Victoria, under similar climatic conditions, sugar from the cane can be produced with advantage. Though the plant will live unprotected in the vicinity of Melbourne, it does not thrive there sufficiently for remunerative culture. But it may be otherwise in East Gippsland, or along the Murray River and its lower tributaries. For fuller information, the valuable work of Mr. A. McKay, 'The Sugar-cane in Australia,' should be consulted.

Egypt.—The sugar-cane was unknown to the ancient Egyptians: it does not appear in those painted and sculptured tombs which, like the Etruscan, have preserved the details of domestic life in remote ages. The date and doum palms, still familiar to the Nile voyager, are portrayed there, as well as the lotus and papyrus, now almost extinct, but never the sugar-cane. Nor is it enumerated, as it surely would have been if known at the time, among the vegetables, "the leeks, and melons, and cucumbers," for which the Hebrews longed, when wandering on the nitrous plateau of the great desert El Tih. And if identical, as supposed, with "the sweet cane" or "calamus," which formed part of the composition of the holy ointment for the Tabernacle, and is mentioned in Solomon's Song and the Prophecy of Jeremiah, it was even so late as the Jewish monarchy brought "from a far country." Hence Dioscorides and Pliny have erred in calling it a native of Arabia, and it is correctly omitted from the list of indigenous products of that country by a most careful writer, Niebuhr the botanist. It

was probably transplanted from India or China in early times, during one of the many migrations which brought the hordes of Eastern Asia to the shores of the Mediterranean. It is mentioned by Greek and Roman authors. The Crusaders found it in Egypt and Syria. Their antagonists, the Saracens, carried it with them into Spain, where it flourishes still in the semi-tropical climate, from Malaga to Motril, having become the parent of a more important cultivation in North and South America.

About the year 1500 Giovanni Lioni says that it abounded in the Thebaid and the north of Africa, and that a considerable trade in sugar was carried on with Nubia.

Bruce, the traveller, saw it in Upper Egypt, and in our own day Dr. Lepsius, of the Prussian Exploring Expedition, found at Kemlin, in the province of Sennaar on the Blue Nile, under the 15th parallel of north latitude, a sugar factory and manufacture of brandy from sugar-cane, conducted by a German, named Beauer, and worked by Arabs and slaves. The principal sugar-growing district in Egypt at the present time extends from Minieh, $28^{\circ} 10'$ N. lat., to Erment above Thebes, $25^{\circ} 30'$ N. lat., occupying both sides of the Nile valley, where it is broadest and richest, above the Delta. The field of canes is, however, interrupted, as in the West Indies, by Guinea corn and vegetables, as well as by cotton and tobacco, and a considerable space is filled with groves of date palm, the fruit of which is an important staple in Egypt, and contributes largely to the revenue.

When Mehemet Ali declared himself sole proprietor of the soil of Egypt, a measure justified according to M. Clot. Bey by the precedent of Joseph, he established large sugar estates and factories on the Nile, the first of which was founded at Reramoon, in 1818. These were originally managed by English, French, and Italians, though now almost entirely by native Egyptians. The works thus built, the surrounding land was parcelled out among the Fellaheen, or peasantry, who were furnished with plants and rude instruments of culture, and compelled to bring in a certain amount of canes per acre, for which they received one-third of the produce in coarse black muscovado, the rest being refined, and sold by the Viceroy in the towns at a price which, in times of unusual abundance, he kept up by exportation. Since his death the system has been much modified; the land has in most instances been resold to the former proprietors, and the factories have passed to the princes of the Viceroy's family.

In a country like Egypt it is extremely difficult to arrive at any accurate statistics. Egypt is fully capable of producing 50,000 tons of sugar, but has not yet reached that figure.

The sugar industry of Egypt has made a great extension of late years, which can best be judged of by the following statistics. In 1833 the production was only about 2510 tons. The exports have since been as follows:—

	Cwts.		Cwts.
1853	29,276	1873	711,327
1863	7,657	1875	901,535
			0 2

The small exports of 1863 to 1866 were due to the extension given to cotton culture in preference to sugar, owing to the scarcity of that staple.

There is perhaps no other instance of a continuously rapid rise in the production of a staple article of commerce, and which, with the annexed Soudan and other districts, bids fair to go on advancing in an equally rapid rate. To the seventeen sugar works previously belonging to the Khedive five more have been added since 1872. The annual production of these twenty-two works is about 14,625 tons. The Khedive has 55,000 acres under sugarcane, and private individuals 35,000. The production of canes is about 53,550 kilos. per hectare ($2\frac{1}{2}$ acres), and the yield of sugar is 8 or 9 per cent. About two-thirds of the sugar produced is white and one-third red sugar.

There are 20 sugar estates with 70 mills. From 1869 to 1878 the average yearly production of sugar was about 28,000 tons; in 1878, 37,733 tons were exported.

Zanzibar.—The soil of this island is eminently adapted for the growth of sugar; labour is cheap, ground rent very low, and every condition exists for securing an ample return for capital sunk in a sugar factory. Sugar to the value of £3000 was shipped in 1864.

Natal.—In 1884, 29,066 acres were under sugar, and the produce returned was 18,771 tons, of which 11,785 tons were exported. The yield varies from 1 to $4\frac{1}{2}$ tons per acre. The latter is exceptional, and 2 tons may be taken as an average on fairly good estates. There are 62 sugar mills in the colony.

The principal article grown on the coast is sugar. Rum is distilled on the sugar plantations to a considerable extent, and meets with ready sale in the colony and for export; 274,281 proof gallons were made in Natal in 1884, about half of which is locally consumed. The duty levied is 4s. 6d. per gallon.

The varieties of cane grown here are the Bourbon, black Cheribon, yellow and ribbon. On some of the estates the sugar is manufactured by the common process, viz., flat open battery and Wetzell pan. As an instance of the cheapness of the plant used, that on one estate, J. Johnston and Sons, Helmsfield, cost but £1300 beyond their own labour, and consists of mill, two clarifiers, flat battery of four pans, with iron teache and dipper. The liquor is reduced to about 26° Beaumé in the teache, from whence it is skipped into a reservoir; after subsiding a short time it is run into a steam pan and finished. The pan is heated by steam coil, the temperature being kept down to about 180° by lathed revolving drums.

Besides the home consumption, the following figures show the progressive exports of sugar:—

	Cwts.		Cwts.
1860	24,369	1874	136,656
1865	74,185	1881	235,700
1870	106,572		

Jamaica.—The exports of sugar from this island have varied of late years from 29,000 hogsheads to 38,000 hogsheads; of rum,

from 16,000 puncheons to 25,000 puncheons. There was, in 1874, 47,565 acres under cultivation with sugar-cane in the island. The attention of sugar planters here has been for some years past given rather to improvement of cultivation than to increase of acreage under canes.

This calculation gives only about three-quarters of a hogshead (or 12 cwts.) as the average produce in sugar for an acre of canes in the colony. The extreme smallness of this return is owing to the system of more or less permanent ratooning practised in small parishes, where on some estates a complete field of yearling plants is hardly ever to be seen; the plants that fail being replaced yearly, plant by plant. Of course the produce is very small, but so also are the expenses and the risk; and it is the opinion of some that the financial result of this cheap system (which avoids the chance of the loss of a field of young plants from a drought) is good. However that may be, the practice greatly reduces the average produce of an acre of cane throughout the colony.

The following shows the exports:—

	Hbds.		Hbds.
1866	33,637	1872	35,553
1867	31,206	1873	28,428
1868	36,259	1874	28,398
1869	29,268	1875	27,847
1870	31,966	1880	32,118
1871	37,010	1882	38,392

Comparison of progress:—

Year.	Sugar.	Rum.
1854	558,571 cwts.	1,665,932 galls.
1864	522,498 "	1,280,854 "
1874	29,398 hbds.	29,378 "
1885	499,713 cwts.	and 19,351 puns.
1886	329,206 "	2,080,471 galls.
		1,476,356 "

The consumption of sugar in the island is estimated at about 6000 hogsheads.

In Jamaica, in the Government botanic gardens, eighteen selected varieties of new canes have been planted out, and as many more are under trial, to ascertain which are the best for general cultivation. Encouraging accounts have been received from different parts of the island of the Salangore cane, which grows with great vigour, and the number of shoots from each stool is remarkable. It requires to be planted wider apart than the space allotted to other canes.

Colonel Stewart's patent for desiccating cane juice by sulphurous acid gas injected into the liquor has been adopted on Bushy Park estate, St. Catherine. On Belmont estate, in the same parish, the double retort system of distillation has been introduced. The high price obtained for rum caused sugar to be sacrificed to a large extent, and the manufacture of rum increased from an average of two-thirds to almost a puncheon for a hogshead.

At Nightingale Grove and Wales estates in Trelawney, centrifugal machines have been erected. In Westmoreland a few more centrifugal draining machines have been introduced, and Wetzell's pan and centrifugal machines have been set up at Holland estate in St. Elizabeth.

Sugar cultivation used to be carried on among the peasantry to a large extent, for a return presented to the Legislative Council in 1871 showed no less than 5615 small sugar mills to be in use. The average make of these is about two hogsheads per annum. In some cases the sugar thus produced was sent down to the coast and exported, but by far the largest part of it is consumed in the island. Since then the number has been reduced concurrently with the abandonment of sugar cultivation by many of the smaller settlers for banana and other products. There are now about 4700 of these small sugar mills. Centrifugal apparatus and other scientific machinery have come into operation, and, out of the 224 sugar estates in operation in 1880, 94 were worked by these modern appliances. Cultivation among the large proprietors has been considerably extended in many cases, and several abandoned properties have been reclaimed and irrigation adopted on a large scale with gratifying results.

Barbados.—This small island usually produces a large quantity of sugar, but the crop is of course affected by seasons and other causes. There are about 100,000 acres under cane.

	Hhds.		Hhds.
1854	50,000	1877	47,879
1864	37,038	1878	43,509
1874	47,355	1879	43,398
1875	65,000	1880	46,867
1876	37,346	1887	68,872

and 355,205 gallons of rum.

The new method of stirring the sugar by the oscillating process, after it has been poured from the copper into the cooler until the granulation is complete, instead of allowing it to cool in a solid mass as by the old process, is now very general. The stirring is commonly effected by a disc revolving in the cooler, which takes up and scatters the fluid sugar. The result is that the sugar crystallizes in larger grains, and parts more quickly and entirely with the molasses, so that there is less drainage on the voyage. Sugar made in this way sells for nearly 2s. a cwt. more than the produce of the same land made by the old process.

Tobago.—The sugar-cane is at present the staple article of production. There are 56 sugar estates in the island. Of the mills on these estates 24 are worked by steam, 6 by steam and water, 11 by water, 10 by wind, and 5 by cattle. All the estates are cultivated more or less on the Metayer system. There are 32 rum stills on the estates, but only about half are at work.

Tortola cannot now, as in her palmy days, boast of wealthy estate proprietors, and the relation existing between the labourer and the estate owners here is very different from that in other and larger colonies. The principle upon which they work is this:

those small farmers who cultivate canes upon their own land allow to the owner of the sugar works one-third of their sugar as payment for its manufacture. Others who cultivate a plot belonging to the same owner as the sugar mill receive one-half of the sugar as their proportion, the other half being claimed by the proprietor of the land and sugar mill as an equivalent for rent and manufacturing expenses.

St. Kitts.—The agricultural progress of this island is shown in the annexed table, exhibiting by quinquennial averages the exports :

Year.	Sugar.	Molasses.	Rum.
	100 lbs.	Gallons.	Gallons.
1853 to 1857	647,733	1,078,914	681,857
1858 „ 1862	787,856	1,396,070	738,229
1863 „ 1867	846,843	1,427,652	314,903
1868 „ 1872	1,012,297	1,642,535	273,460
1873 „ 1877	748,602	1,236,586	529,967
1878 „ 1882	1,114,269	2,224,723	287,284

The agriculture is of the most advanced and scientific character. The old wind and cattle mills have been almost entirely superseded by the steam engine.

Sugar is almost the chief product of Nevis.

It may be well to publish here for reference by the planter the analyses of twelve different specimens of canes, by Dr. Stenhouse :—

	Trinidad.				Berbice.			Demerara.	Grenada.	Jamaica.		
	1	2	3	4	5	6	7	8	9	10	11	12
Silica	45.97	42.90	46.46	41.37	46.48	50.00	45.13	17.64	26.38	52.20	48.73	54.59
Phosphoric acid	3.76	7.99	8.23	4.59	8.16	6.56	4.88	7.37	6.20	13.04	2.90	8.00
Sulphuric acid	6.66	10.94	4.65	10.93	7.52	6.40	7.74	7.97	6.08	3.31	5.35	1.9
Lime	9.16	13.20	8.91	9.11	5.78	5.09	4.49	2.34	5.87	10.64	11.62	14.36
Magnesia . . .	3.66	9.88	4.50	6.92	15.61	13.01	11.90	3.93	5.48	5.63	5.61	5.30
Potash	25.50	12.01	10.63	15.99	11.93	13.69	16.97	32.93	31.21	10.09	7.46	11.14
Soda	..	1.39	..	..	0.57	1.33	1.64	..	..	0.80	..	..
Chloride of Potassium . . .	3.27	..	7.41	8.96	..	..	..	10.70	11.14	..	16.06	0.84
Chloride of Sodium . . .	2.02	1.62	9.21	2.13	3.95	3.92	7.25	17.20	7.64	4.29	2.27	3.83

The first seven were all fine canes with the leaves; the eighth had no leaves; No. 9 but few leaves; No. 10 was in full blossom, and had been manured with pen manure; No. 11 were old ratoons manured in the same way; and No. 12 were young *Mont Blanc* canes, manured with pen manure, guano, and marl. This is a valuable analysis, from having been made from entire canes.

By comparing these elements together we observe that the proportion of potash and silica is great in all of them; phosphorus, sulphur, and lime also exist in considerable quantities in all the specimens, while soda is variable in some and non-existent in others, and chloride of sodium, or common salt, is abundant in the Demerara specimen, and varies much in the different specimens. We may therefore conclude that the sugar-cane is a plant requiring :—

1stly. A considerable supply of those two substances found generally coexistent with nitrogenized compounds in all animals and vegetables, viz. phosphorus and sulphur.

2ndly. A large supply of potash and silica, particularly the last.

3rdly. That lime and magnesia are also essential ingredients (the first in the larger quantity), while soda is not essential to its growth, and that common salt, while appearing also to be an essential ingredient, is not so in any large quantity, but if presented to the cane may be absorbed by it to a great extent, no doubt injuriously.

Dominica.—The following gives the exports for this island some years ago, but I have no more recent details:—

Year.	Sugar.	Molasses.	Rum.
	cwts.	galls.	galls.
1867	56,337	54,400	55,063
1868	68,942	95,520	49,740
1869	65,650	90,940	45,719
1870	73,203	88,732	36,021
1871	66,220	94,015	40,615

Montserrat.—A principal export of this island is sugar; in a good year the crop will yield 2500 hogsheads and 400 puncheons of rum. Many sugar works are furnished with steam engines, but others still rely on wind, water, and cattle power. A large proportion of the agricultural labourers and rural artisans, carpenters, masons, &c., are owners or renters of pieces of land, ranging from half an acre to two or three acres in extent, and planted in canes or provisions. The lower slopes of the loftier, and the summits of the lower, hills of this mountainous little island are marked by the clearings of these small cultivators, and nothing can surpass the vigour and energy with which this peasantry of African descent labour on these holdings of their own. Here and there may be seen the creaking cattle mill and even windmill which, with a little boiling house, some labourer or mechanic, intelligent, frugal, and enterprising beyond his fellows, has contrived to erect, and to this little factory his neighbours carry their bundles of ripe canes to be converted into sugar, one-third of which is kept as remuneration for the manufacturer. The sugar lands of many proprietors of considerable importance are cultivated more or less on the half system, a system by which the peasant occupiers of small plots of land are bound to grow canes which are brought at crop time to the works of the proprietor, who retains half the sugar produced as rent for his land.

Antigua.—The average production of sugar in this island is about 15,000 hogsheads, of molasses 7000 puncheons, and a very little rum.

St. Lucia.—In possessing a central sugar factory, perfectly equipped with the best machinery, St. Lucia is almost alone amongst the British possessions in the West Indies. Not only has the original factory, in which the Government has a considerable

stake, been at work for some years, but two or three attempts have been made quite recently to follow the example of its success. The island appears better suited for sugar cultivation than its neighbours, inasmuch as the valleys, which run down from the sea, spread out into plains inland, instead of being more and more confined by mountains. Had it not been for the low price of sugar of late years there would probably have been at least three sugar factories working full time in the colony, and, in any case, no colony will in future do better in sugar than St. Lucia.

The increased production of sugar in St. Lucia is attributed both to extended area of cultivation and to improvement in culture. That less energy is shown in the latter respect is considered to be owing—in a measure—to the extraordinary fertility of the soil, which, not uncommonly, produces a crop from the same cane plants for twenty years in succession; whereas, in most other countries, the fields require to be planted every two or three years. The system of agriculture, as in most of the West India Islands, is somewhat rude; but signs of efforts to improve it are not altogether wanting. Virgin soil is being broken for the purpose in all directions; and, while no estates have latterly been abandoned, some have been reclaimed, and others, which a few years ago grew little else but weeds and trees, are now yielding abundant crops.

Besides extension of cultivation, there is a progress in manufacture which makes further improvement probable, and will certainly render it more easy. There are four large central factories fitted with every modern improvement, which, situated in localities favourable to cane cultivation, manufacture the canes of contributory estates into pure white crystals on the most economic principle. The shipments of sugar and its products have been as follows:—

Year.	Sugar.	Molasses.	Year.	Sugar.	Molasses.
	lbs.	gallons.		lbs.	gallons.
1870	12,444,153	2,461	1882	16,813,860	304,500
1880	14,742,880	250,000	1883	17,090,356	209,250
1881	11,318,050	226,800	1884	18,976,592	335,900

Grenada.—There are very few estates under cultivation with sugar, and the produce is chiefly consumed locally. The great difficulty with which planters here have to contend is the paucity of labour and the badness of the roads. Whereas in this island nature is so bountiful that a family with but little labour can raise their own fruit and vegetables on an acre or two of land, where also, from the habits of the negroes and the climate, their wants and requirements are but few, it cannot be expected that they will labour on estates more days than sufficient to supply such requirements. The exports are about 3000 tons of sugar and 50,000 gallons of rum.

St. Vincent.—The following table gives a comparison of the exported produce of this colony some years ago:—

Year.	Sugar.	Rum.	Molasses.	Year.	Sugar.	Rum.	Molasses.
	hhds.	puns.	puns.		hhds.	puns.	puns.
1862	8,503	1,827	305	1867	11,137	1,683	1,209
1863	8,756	1,554	409	1868	11,248	1,634	1,359
1864	8,163	1,284	1,418	1869	11,164	358	3,783
1865	8,454	1,794	916	1870	12,948	2,155	1,638
1866	10,984	1,796	1,063	1871	13,315	2,656	953

In the good old times the profit on a hogshead of sugar was between £30 and £40.

Although no additional land has been brought into cultivation, by more attention to clearing the canes and a greater use of manures, a rather larger yield per acre has been obtained.

Trinidad.—About £1,000,000 a year is the value of the products of the sugar-cane in this island in good years.

The exports were in—

Year.	Sugar.	Molasses.	Rum.
	lbs.	galls.	galls.
1854	50,055,998	782,401	285,446
1864	79,109,650	1,576,105	60,075
1874	99,739,550	1,697,131	39,761
1884	122,071,040	2,245,650	43,581
1885	142,640,960	2,416,761	72,525

In 1796, 159 sugar plantations produced 7800 hogsheads of sugar; in 1802, 192 estates produced 15,461 hogsheads.

A large Usine has now been for some years at work for the Colonial Company in the midst of their estates in Naparima, Trinidad.

In Trinidad, as in all the other West Indian colonies, sugar is the great staple industry. Here, however, it is not, as in most of those colonies, the only one on which the colony depends, nor was it even the first in the field, for cacao had been cultivated for a century or more before the first sugar estate was established. The Otaheite sugar-cane was introduced into Trinidad from Martinique by M. St. H. Begorrat in 1782, and the first sugar estate was established by M. Picot de Lapeyrouse in 1787. From that time up to the date of the capture of the island by the British, the cultivation of the sugar-cane increased steadily but slowly. The British occupation seems, however, to have given a great impetus to the sugar industry, the exports of sugar having more than doubled during the first six years thereof.

In Trinidad there are about 52,150 acres under cane and 21,279 under cacao and coffee.

Cultivation at the present time is carried on under great disadvantages, principal among which, in addition to the low price of sugar, is the great scarcity of labour which prevails at the most critical period of the growth of the cane.

The cost of production is strongly influenced by the labour supply, and the temptations to settle in the woods and cultivate provisions on their own account, are sufficient to draw a steady stream of labourers away from the sugar estates. Considerable numbers also find their way to the cacao plantations, their loss to the sugar estates being made up by fresh importations at the expense of the planter.

It will thus be seen that the latter has to bear the greater part of the cost of the development of the island, and this fact has more to do with the apparent cost of production of sugar than any serious defects in the present system of manufacture.

With the close of the crop in the month of May, commences the rainy season. At this time, as the cane cultivation is quite young, it is important that it be kept perfectly clean and free from water. But this is also the time for planting rice and ground provisions, and large numbers of labourers who gladly work on the estates for the eight or nine months previously, betake themselves to their own patches to establish their crops. The effect on the cane cultivation can be readily imagined, and it will be understood that their return, at the end of from two to three months, is too late to prove of much benefit.

As important factors in keeping up the cost of production, some stress has been laid upon slovenly manufacture and waste in the sugar works. Sweeping charges of this kind are most unjust. Individual instances of carelessness are not wanting, but, on the other hand, there are not wanting instances of the application of great energy and intelligence.

West Indian Sugar competes with Beet upon very unequal terms. In addition to the Continental bounties it is handicapped by the cost of an expensive system of Immigration, the distance from the coal pit and the market are serious drawbacks.

The cost of production of a ton of West Indian Sugar in the best regulated factories at the present moment, cannot be taken at less than £11 10s., the charges being much in the manner shown :—

Growing—		£.	s.	d.
Cultivation, cutting, and transport		3	6	2
Stock		0	12	8
Maintenance		0	8	2
Hospitals for immigrants		0	5	6
Management and sundries, including immigration		1	7	6
Manufacturing		5	10	0
		£11 10 0		

Of this sugar not more than 75 or 80 per cent. is fit for direct consumption, the remainder being syrups at a polarization of 88 or 90 per cent. Up to the present time the extraction of the juice has been effected by crushing in powerful mills, but diffusion on the continental system is now exciting some attention. It, however, involves a question of fuel which in the West Indies is always a serious one, and as the exhausted cane slices could not be

used in the furnaces without an expensive process of drying, its advantages are by no means a settled question.

Since then the cultivation has been gradually extended, until sugar has become the chief product of this colony, the exports in 1885 reaching 63,679 tons, besides 2,216,761 gallons of molasses, and 72,525 gallons of rum.

PRODUCE OF THE COLONY SHIPPED.

Year.	SUGAR.						Total Sugar reduced to Hhds.	MOLASSES.		RUM.
	Muscovado and Vacuum-pan.			Concrete.				Puns.	Tierces.	Puns.
	Hhds.	Tierces.	Barrels and bags.	Hhds.	Tierces.	Barrels andbags.				
1868	46,955	6,727	3,539	600	339	..	52,708	16,524	726	315
1869	49,373	7,476	2,629	1,637	..	..	56,322	19,801	968	102
1870	39,516	6,060	2,062	1,515	134	..	45,418	12,678	684	2
1871	56,648	11,407	4,098	155	3,592	..	67,315	19,560	994	260
1872	43,840	9,202	2,369	..	2,415	..	51,881	14,510	733	91
1873	50,079	8,248	2,231	..	2,583	..	57,571	14,071	782	57
1874	41,412	8,496	7,601	..	1,836	..	49,250	14,676	814	352
1875	57,308	13,172	29,071	..	3,053	..	71,758	19,965	1,143	366
1876	45,917	9,538	31,249	..	2,912	..	58,123	17,378	1,001	123
1877	35,785	9,621	34,834	..	2,418	..	48,165	11,972	1,075	1
1878	47,459	11,345	44,166	..	3,054	..	62,579	19,085	1,474	2
1879	46,712	14,406	70,429	..	3,084	..	67,175	14,578	898	511
1880	36,794	12,199	71,114	..	2,427	..	55,433	12,846	888	170
1881	32,721	9,352	63,773	..	..	11,221	48,330	12,876	790	10
1882	39,808	11,945	86,329	..	..	17,758	60,782	17,937	109	80

Exports of sugar from Trinidad :—

				Cwts.					Cwts.
1860	..	..	..	540,678	1880	..	..	..	1,067,680
1870	..	..	..	819,043	1885	..	..	..	1,273,580

Bahamas.—The sugar-cane grows luxuriantly in many of the islands of this group, and is largely cultivated. The production is about 2500 tons.

Martinique.—In this island the number of hectares under culture with the cane in 1874 was 19,314, and there were 564 sugar pieces and small plantations. The number of labourers employed was 33,643. There were 88 sugar estates possessing steam mills, and 14 central Usines or sugar works. There are now 519 plantations with 56,000 acres under culture.

The production has been as follows :—

Year.	Sugar.	Molasses.	Rum.
	Kilos.	Litres.	Litres.
1865	32,691,550	7,909,700	6,220,500
1874	38,653,000	6,206,000	5,320,000
1885	39,736,204	17,240,000	12,000,000

Martinique has reduced its production of sugar to distil more rum.

The imports of French colonial sugar at Marseilles were in

							Kilos.
1884	..	..	..	..	..	..	39,698,000
1885	..	..	..	..	..	..	32,591,000
1886	..	..	..	..	..	..	40,265,000
From	Guadaloupe	..	..	..	..	..	20,000,249
„	Martinique	..	..	..	..	..	3,977,775
„	Réunion..	..	..	..	..	..	15,911,255
„	Mayotte, Nossé-Bé	..	..	..	..	..	345,745
							40,265,024

The sugar crop of Martinique is probably less than one-half of that of Trinidad; the superior quality, however, manufactured by the Usines raises the value of the crop much more in proportion.

The finest soil lies to the north and north-east of the island, where the estates are on a much larger scale than on the south side; the soil is volcanic, and cartage of canes or produce practicable at all seasons.

The seasons also are not so marked on the north of the island, less rain falling in the dry season than elsewhere; so much so that sugar making and cultivation may be carried on at almost any period of the year. The showers fall principally in the early morning.

There are no Usines to the north. The largest estate there makes nearly 1000 barriques, equal to about 450 hogsheads of a ton weight. The average crop of an estate is, however, from 500 to 600 barriques.

The Usines are principally erected in the southern part of the island, in the direction of and beyond Fort de France (as it is now called), where the country is more level, and the facilities greater for bringing the canes by rail to the Usines. The estates by which these Usines are now fed were formerly small properties, with inferior machinery of little power, making each from 140 to 180 tons of sugar. These small estates now grow more than double their former crops, which are manufactured on the Usines into sugar of three qualities, *i.e.* first-class sugar, of large and strong crystals, and to all intents and purposes white; the second-class article, made from the molasses boiled a first time, resembles the ordinary crushed sugar imported from England, but is not quite so white; the third-class is superior in colour to the best muscovado, though somewhat inferior in grain.

The greater number of the Usines are in the vicinity of the Bay of Fort de France, within easy water communication, or having tramways from the establishments to their wharves.

Most of the Usines make only first jet, *i.e.* sugar extracted from the cane juice, and second jet, that made from the first molasses. The difference in the two classes of sugar is trifling, but third and fourth jet are much inferior, and require a great extent of cooler-

room, the *masse-cuite* of these jets having to remain at times six to eight weeks in the coolers to granulate, and most Usine directors prefer to convert their second molasses into rum. The rum made in these factories is of very superior quality.

The following schedule shows the number of pounds of canes ground to make each hogshead of 1102 lbs. of sugar; and canes ground for each 100 lbs. of sugar, made in the year 1871, in three Usines, with the expenses in francs for the canes taken to make each hogshead, manufacturing or current expenses of the factory per hogshead during the twelve months, and net profit.

Name of Usine.	Number of lbs. of Canes ground per		Cost per Hogshead.			Net Profit to Usine per Hhd. of 1102 lbs.
	Hhd. 1102 lbs. Sugar.	100 lbs. Sugar.	Canes.	General Expenses.	Total.	
La Renty	14,007	1,275	frs. cts. 143 43	frs. cts. 77 24	frs. cts. 220 67	frs. cts. 107 68
François	13,853	1,257	139 31	81 52	220 83	129 96
Pointe Simon.. ..	15,056	1,368	153 98	71 29	225 27	100 55
Average	14,305	1,300	145 57	76 68	222 26	115 73
Equal in sterling to			£ s. d. 5 16 5½	£ s. d. 3 1 4	£ s. d. 8 17 9½	£ s. d. 4 12 7

Thirteen tons of canes for one ton of sugar. Or, in other words, for each hundred pounds of canes purchased by the Usine, the planter received $9\frac{3}{4}d.$; the general expenses of the Usine were, during the twelve months, $5\frac{1}{2}d.$ on every hundred pounds of canes ground, and the profit on each was $7\frac{3}{4}d.$

Formerly few estates' mills, driven by steam or water power, extracted more than 50 per cent. weight of juice from canes ground; windmills and cattle mills seldom or never did this; and under the bad system of defecation and concentration generally practised on small estates, one pound of dry sugar per gallon of juice was considered the average yield. Under such circumstances, the planter who is relieved from the trouble and expense of manufacture, and receives for his canes the value of 5 per cent. of dry sugar—good fourths—drives a profitable business, unless he can have at his disposal capital sufficient to erect a good plant.

One hundred pounds of canes yielding juice of 10° B. will, at 50 per cent. extraction, give, in cane juice, 4·714 gallons.

	Gallons.
55 per cent. will give.. ..	5·185
60 " "	5·657
65 " "	6·128
70 " "	6·600
75 " "	7·071
80 " "	7·543

In *Guadaloupe* there were, in 1874, 20,686 hectares of land under culture with sugar-cane. The number of sugar works was 495, of

which 59 had mills worked by steam, 80 by water-power, and 80 windmills, and 1 by cattle; 264 plantations without works are served either by the 11 central steam Usines, or other mills conveniently situated. The number of labourers employed was 44,856. There are now 610 sugar plantations; 27 are worked by steam; 118 by wind, water, or earth; 8 are central steam works; and 469 are small properties, which have no sugar mills. The produce made was in

Year.	Sugar.	Molasses.	Rum.
	Kilos.	Litres.	Litres.
1865	30,328,452	4,311,972	1,819,312
1874	40,775,732	3,400,438	1,849,385
1885	44,497,720	4,000,000	2,314,000

St. Croix.—The aid of steam in breaking up the heavy soil of this island is much desired, but the total failure of a steam-traction plough, introduced in 1862, has hitherto discouraged the planters from again risking so heavy an outlay.

St. Croix produces about 6000 tons.

The exports in 1870 were 22,968,214 lbs. of sugar, 437,058 gallons of rum, and 730,677 gallons of molasses; in 1871 the quantity of sugar exported was 25,223,547 lbs.

In 1873 the exports were 9,852,803 lbs. of sugar, 144,041 gallons of rum, and 354,442 gallons of molasses.

Colonel Stewart's process for improving the quality of sugar has been introduced, and resulted in making a superior article, where proper chemical knowledge has regulated the proportions of lime and sulphur required in the manufacture, having also due regard to the character of the water, which is often mixed with mineral deposits, as it is raised from a great depth and frequently through a lime or marl substratum.

Porto Rico.—The average crops were in

							Tons.
1853-57	..	..	..	..	..	..	80,743
1869-73	..	..	..	..	..	..	95,532
1875-80	..	..	..	..	..	..	73,098

The largest crop was 103,304 tons in 1871. The average, it will be seen, is about 83,000 tons. The following shows the shipments:—

							Tons.
1875	..	..	..	82,135	1878	..	82,974
1876	..	..	..	68,830	1879	..	68,225
1877	..	..	..	62,328	1883	..	79,738

The finest qualities of sugar are produced in the divisions of St. Juan, Mayaguez, and Ponce, and the muscovado sugars in Vieques, Naguabo, and Arroyo. The Americans take the greater portion of the former. 32,282 gallons of rum were shipped in 1873.

Cuba.—This island has always been a large sugar-producing

colony, and has steadily maintained its progressive increase and the quality of the sugar produced, notwithstanding many adverse circumstances. The sugar crop and export last for about four, or at most six, months of each year.

Two facts strike the spectator who is accustomed to the culture and manufacture in the British West Indies, namely :

1. The inferiority of the culture of the cane in Cuba compared to that in Demerara, Barbados, Trinidad, Jamaica, &c., and the smallness and poor quality of the different species of canes in the Cuban fields.

2. The vast superiority in Cuba of the manipulation of the cane juice, and the excellence and high quality of the sugar produced.

There are about 1400 sugar estates in the island.

In 1840 the sugar crop was 143,600 tons; in 1853, 267,850 tons.

In 1855 the exports from Cuba were 1,905,580 boxes of sugar, 256,100 casks (of 30 gallons) of molasses, and 31,214 pipes of rum.

In 1863, 40 per cent. of the sugar and 77 per cent. of the molasses went to America; 34 per cent. of the sugar to England. In 1873, 64 per cent. of the sugar and 91 per cent. of the molasses went to America, and 25 per cent. of the sugar to England.

	Year.	Sugar.	Molasses.
		Tons.	Tons.
	1864	515,090	203,450
	1865	619,780	218,075
	1866	612,180	241,150
	1867	597,146	226,200
	1868	749,389	286,151
	1869	726,237	279,570
	1870	725,505	245,870
	1871	547,179	184,965
	1872	708,234	235,441
	1873	796,179	242,308
	1874	666,000	..
	1875	700,000	..
	1876	566,266	..
	1877	500,000	..

EXPORTS.

	Year.	Sugar.		Year.	Sugar.
		Tons.			Tons.
	1869	739,406		1878	474,429
	1870	659,886		1879	623,935
	1871	470,941		1880	495,429
	1872	630,862		1881	449,067
	1873	714,960		1882	381,681

The quality of the sugar exported from Cuba is excellent, and is superior to most of the sugar produced elsewhere, from the

scientific way in which it is manufactured from the cane juice. The sugar works on most Cuban estates are as good as any of the large German beetroot sugar factories, where the newest and best appliances are ever in use.

Sugar is exported from Cuba chiefly in boxes or cases, of which about $3\frac{1}{4}$ are equivalent to one hogshead. The hogshead generally weighs net about 1500 lbs. English. They are smaller than the Jamaica hogshead.

The *molasses* produced in Cuba is not large, as will be seen by the previous statement, and much of it is now re-worked for sugar; a very small quantity of rum is exported, in casks of from 110 to 120 gallons.

New Caledonia.—The sugar industry was only commenced here in 1870; now there are 7 mills, and 1000 tons of sugar are produced.

At *Tahiti* there are about 250 acres of land under sugar-cane, and three small sugar mills in operation. In 1874 there were 290 acres, and the produce was 40,000 kilos. of raw sugar, and 71,400 kilos. of turbinéd. The quantity is now only 71,500 kilos. of sugar and 75,000 litres of rum.

Hawaiian Islands.—The climate and soil of these islands are peculiarly adapted to the production of sugar, as the cane has continuous summer, so that a single crop can have from sixteen to twenty months, the time usually occupied to complete its growth.

There were in 1868 10,260 acres planted with cane, and the monthly expenses were about £980. The actual cost of producing sugar on an old plantation free from incumbrance does not exceed 2d. per pound for all grades manufactured.

Sugar is the great staple of the country, and immense capital and energy and great intelligence have been expended upon the industry. The result is an increase in the yield from 12,000 tons in 1875, to 75,000 or 100,000 tons in 1887. There are fifty sugar estates with mills, besides 75,000 acres of land possible for cultivation of the cane. The planters of Hawaii have two methods of producing sugar-cane, viz., where they depend upon the natural rainfall, and where they resort to irrigation. The best cane for planting is that which has the shortest joints. The distance between the joints proper varies from 2 to 10 or 12 inches. Long-jointed cane is considered best for grinding. The cane when cut is delivered on the corner of the three roller mills, and with the assistance of two men to feed it, passes through the rollers under heavy pressure, and the juice, to the extent of from 50 to 65 per cent., is extracted. The cane residuum, or bagasse, is passed through a second mill, where from 10 to 15 per cent. more juice is extracted. This is called double crushing, and if water is used on the bagasse before the second grinding, it is called maceration. As the juice is extracted it is pumped through the heaters into the clarifiers, or large iron tanks, with copper or brass steam coils, in which the juice is heated to a temperature of 200° to 210°, and lime is added to correct the acidity and aid in defecation. The juice is afterwards thoroughly

cleaned by means of heat, and the water evaporated from it until the concentrated liquor stands at about 26° to 30° Beaumé, when it is ready for the vacuum pan. The work of the vacuum pan is to take in a certain quantity of this concentrated liquor at a temperature not above 150° Fahr., and to boil it down to what is known as the striking point, that is about 40° Beaumé. When the sugar boiler considers that he has obtained the right quantity and density, he admits a charge of cold liquor, which has the effect of separating the small particles of saccharine, or crystallisable sugar, and is called "starting the grain." After proper boiling or concentration, another charge of cold liquor is taken into the pan, and the effect is to build up or enlarge the grain so started, and the operation is continued until the vacuum pan is sufficiently filled with sugar of the required grain. Closing in, or finishing the strike, consists of boiling the mass to such state or consistency as is best for drying, and the vacuum is then broken, and the whole mass discharged into a receiver or mixer ready for the dryers. The drying is done by centrifugal motion, which separates the molasses by whirling them through fine wire cloth or screens, and leaving the dry sugar in walls on the inside. The dry sugar is put into bags or other receptacles, ready for the market, while the molasses are reboiled in the vacuum pan, and made into sugar of lower grade.

Fiji.—Prior to 1875, in which year these islands were acquired by Great Britain, only one or two mills of small capacity were at work. This condition of things continued with but little improvement till 1881. In that year the Colonial Sugar Refining Company of Sydney, encouraged by certain facilities offered to it by the Government, and the guarantees which intending planters willingly gave, decided to erect a large central factory in the district, through which runs the broad and navigable river, the Rawa. Other companies, as well as some private individuals, also began about this time to turn their attention to the cultivation of the rich alluvial flats which are to be found along the course of other watersheds. Moreover, on more than one of the islands of the group, the extensive areas of purely volcanic soil were found admirably adapted to the growth of the sugar-cane, and have accordingly been utilised for the purpose. With such vigour have these several enterprises been conducted, that there are now no less than twelve mills in existence, having an aggregate power equal to the production of 30,000 tons of dry sugar during the seven months from June to December, which constitute the best season for crushing. There are no less than thirteen plantations affiliated to the Colonial Sugar Refining Company alone; and for the purpose of bringing the cane to their mill from a limit of 15 miles above and 10 miles below it, it is found necessary to keep two powerful steamers, six steam tugs, and some fifty lighters, capable of carrying 40 tons each, in constant employment; on other estates, where the land carriage is used, many miles of permanent tramway have been laid down, and long lines of laden trucks are drawn by locomotives to the rollers. The plantations vary in

area from 50 to 700 acres, while the fact that the planters are desirous of extending their cultivation to the utmost would seem to furnish sufficient proof that, so far, their efforts have been attended with success. Plant cane, eighteen months old, has been known to yield as much as 70 tons to the acre, but taking one season with another, and assuming the crop to consist of two-thirds ratoons and one-third plant canes, it is not safe to reckon on more than 28 tons to the acre, but in some instances far higher results are obtained. However, taking these figures, it will be seen that the planters can with safety rely upon a gross profit of £14 at least, whereas with prudence the cost of cultivation, when the plantation has been opened up, will not exceed £10 10s. The capital required to open up an estate of 100 acres, so as to produce the above results, will not exceed £2,700. With the most modern appliances for manufacturing, the yield of sugar is at the rate of 8 per cent. of the quantity of cane passed through the rollers, and the cost of producing the ton of sugar is £10. In 1885 there were 12,000 acres under sugar. The sugar exported has been in

								Tons.
1884	..	..	..	..	..	..	..	8,729
1885	..	..	..	..	..	..	..	10,586
1886	..	..	..	..	..	..	..	16,000

MAPLE SUGAR.

Although the sugar obtained from the sap of the maple is not a tropical product, yet I include a short notice of it here as supplementing to a small extent the supply of sugar in North America.

The sugar maple (*Acer saccharinum*) flourishes throughout most of North America. Its height is often upwards of 100 feet. In the production of sugar an orchard of maple trees is equal to a field of sugar-cane of the same area. An open winter, constantly freezing and thawing, is the forerunner of a bountiful crop of sugar. Maple sugar has an after-taste of vanilla flavour which distinguishes it from all others.

In the older States of the Union the great demand for timber and fuel and the increased cutting tend yearly to lessen the amount of sugar produced. In the more recently settled States of the north-west, maple sugar is on the increase.

The maple sugar crop of the year 1855 was officially estimated at Washington at about £550,000. Maple sugar being a product of the forest, is chiefly confined to those regions of the interior where it is a cheap and ready substitute for the more costly product of the cane. The sugar-cane can only be raised in the extreme southern latitudes of the United States, whereas the sugar maple flourishes in the greater part of the inhabited sections, and though the sugar produced from it is inferior to that of the cane, yet, as it requires but little care, it is much cheaper.

In 1850 the production in the States was officially given at 15,520 tons, in 1855 at 14,500 tons, in 1858 at 24,000 tons, in 1860 and 1861 at an average of 27,000 tons, in 1870 at 13,000 tons, and in 1872 it was only 16,000 tons. Estimating the sugar and syrup obtained at 60,000,000 lbs., worth 10 cents a lb., this gives a total value of £1,200,000.

Maple sugar as an article of merchandise seems, however, in a fair way of extinction. The maple forests of New England are being yearly cut down and converted into broom handles. Thousands of splendid trees are annually felled. At the present rate of destruction, maple sugar will before long be unknown in the trade. The whole amount of maple sugar reported in the States was, according to the latest official agricultural statistics, about 40 million pounds annually, but this was considered to be one-third below the actual quantity made. According to the last census returns, Vermont reported a yield of almost 10 million pounds. The production of New York is somewhat larger, but nothing compared with the difference in area. The only other States which return more than a million pounds are Michigan 4 millions, Ohio $3\frac{1}{2}$ millions, Pennsylvania nearly 3 millions, New Hampshire $2\frac{1}{2}$ millions, Indiana $1\frac{1}{2}$ millions, Massachusetts a few pounds more than a million. The total production of maple molasses is $1\frac{1}{2}$ million gallons, of which Ohio returns nearly 400,000 gallons, Indiana nearly 300,000, Kentucky 140,000, and Vermont only 16,000 gallons. In addition to the large production of maple sugar in the States, the estimated quantity manufactured by the Indians living east of the Mississippi is 10 million pounds per annum, and the quantity manufactured by those living west of the river is set down at 20 million pounds, but is probably much greater. Of the American States, Vermont makes by far the largest quantity in proportion to its territory, and in some of the northern districts of this State the use of cane sugar is almost unknown. Many improvements have been made in the manufacture of maple sugar during the last few years; formerly the highest attainments in this manufacture only resulted in the production of a fine muscovado-like sugar; but now, by improved processes, specimens are annually exhibited at the various agricultural fairs, vying with the most beautiful loaf sugar. This has been effected by greater attention to cleanliness in the preparation of the sap, and the improvements in the graining and refining the sugar. A few years ago a premium was awarded by the Oswego County Agricultural Society, New York, to Mr. R. Tinkor, for the following improved method of preparing maple sugar: The sap is boiled in a potash caldron kettle to a thick syrup; strain it when warm, let it stand twenty-four hours to settle, then pour it off, leaving back all that is impure. To clarify fifty pounds, take one quart of milk, one ounce of saleratus, and the whites of two eggs well mixed; boil the sugar again until it is hard enough to lay upon a saucer, then let it stand in the kettle and cool. Stir it a very little to prevent it caking in the kettle. For draining use

a tube, funnel-shaped, fifteen inches square at the top, and coming to a point at the bottom. Put in the sugar when cold, tap at the bottom, and keep a damp flannel cloth of two or three thicknesses on the top of the mass. When drained dissolve the sugar in pure warm water, and clarify and drain as before.

It is about the close of April that the collection of the sap is made. Réaumur's thermometer rises about midday to 50°, and falls each night to zero, or below. In Canada an incision or a hole is cut in the trunk a few feet from the ground; in the United States the large branches are also punctured; a recipient is placed to catch the sap. To save transport and to accelerate and simplify the manufacture, a rough shed is run up in the woods, and a large boiler is suspended over a brisk fire. The sap is thrown into it and stirred with a wooden spade. When it boils, it thickens, changes its white colour into a golden yellow, and is poured out into wooden moulds, in which it solidifies on cooling; sometimes it is turned out into earthen pots, which bleaches it, but the quality is sacrificed to colour. In the work of Michaux on 'The Forest Trees of North America,' some interesting details will be found of the process as carried on in the States. They commence there tapping the trees in February and March; a cold and dry winter is much more productive of sap than a humid and variable one; and a fine sunny day after a frosty night causes the sap to flow more abundantly, and a tree will occasionally yield two or three gallons. Michaux states that three persons can attend to 250 trees, which would yield 1000 lbs. of sugar, or about 4 lbs. per tree. The period during which the sap flows from the trees is about six weeks, at a time when there is little to be done in farming or other operations. The maple sugar product of Canada was stated in 1849 at 2,303,000 lbs. for the Lower Province, and 4,161,000 lbs. for Upper Canada. The census of 1851 gave the total at 10,000,000 lbs., exclusive of what was used locally without being brought to market. In 1870 it was returned at 20,556,049 lbs.

The produce of sugar is about one pound to five gallons.

Maple sugar is made not so much as an article of commerce, as for the home use of the producers. A considerable proportion of the maple sap product is also preserved as syrup without crystallisation, and in this state it is used as sweet sauce, and for various culinary purposes.

PALM SUGAR.

In British India and several parts of the Eastern Archipelago, sugar is made from the sap of some of the palms, such as the Indian wild Date palm of Bengal (*Phoenix sylvestris*), the Palmyra palm (*Borassus flabelliformis*) of Southern India, Bombay and Burma; the Coconut palm (*Cocos nucifera*), the Gomuti palm (*Saguerus [Arenga] saccharifera*), the Nipah palm (*Nipa fruticans*), and the Kittool palm of Ceylon (*Caryota urens*). About 50,000 tons

of palm sugar are produced in Bengal alone, and a good deal in Siam; probably 150,000 tons is below the mark for the entire produce. Palm sugar or jaggery is not granulated, nor are its particles free, but it is a coagulated mass, smooth, adhesive, and gummy to the touch. Palm sugar is collected in large quantities by the natives in Java, and sold in the markets in packets enveloped in leaves. I have preferred to treat of this manufacture under the head of "The Useful Palms," to which section the reader is referred for full details.

BEETROOT SUGAR.

Of all the plants experimentally tried for sugar, the beet proved the most promising, but forty years elapsed before the manufacture of beet sugar was enabled to cope successfully with colonial sugars. From France, the culture spread through Belgium, Germany, and far into the interior of Russia, and now there is produced on the continent of Europe 1,200,000 tons, of which about one-fourth is manufactured in France.

The manufacture of beet sugar on the continent having lost the advantage of protective duties and bounties on export, it is not necessary now to go into elaborate details as to the extent of production and processes of manufacture. It will suffice to give a few general statistics as to the principal producing countries.

The manufacture has been unsuccessfully attempted in England and Ireland. In New Jersey, California, Canada, and parts of Australia, attempts have also been made to grow the beet for sugar production. Owing to the smaller quantity of saccharine in beet-roots than in sugar-cane, and owing also to the more intricate and complex combinations in which that saccharine matter is found in the root than in the cane, greater ingenuity and a more careful application of scientific processes are needed in the one than in the other.

In 1887, in the annual report of the Rotterdam Chamber of Commerce, it was estimated that the system of protection or bounties on beet sugar production involved a loss of the following sums to the Continental States:—

France..	..	..	..	..	..	..	..	£	3,250,000
Germany	..	..	..	..	..	..	..		1,885,000
Austro-Hungary	..	..	..	..	..	..	..		500,000
Belgium	..	..	..	..	..	..	..		812,000
									£6,447,000

The production of beet sugar in the two chief European producing countries is thus given in the annual report of the Marseilles Chamber of Commerce, in tons:

Year.	Germany.	France.	Year.	Germany.	France.
1877-78	373,000	397,000	1882-83	825,000	423,000
1878-79	426,000	432,000	1883-84	925,000	450,000
1879-80	409,000	277,000	1884-85	1,150,000	325,000
1880-81	559,000	233,000	1885-86	838,000	298,000
1881-82	599,000	393,000	1886-87	1,012,000	500,000

The export of beet sugar, raw and refined, from Germany and France has been, in tons:—

Year.	Germany.	France.	Year.	Germany.	France.
1877	99,000	269,000	1882	482,000	164,000
1878	141,000	202,000	1883	600,000	184,000
1879	137,000	186,000	1884	750,000	111,000
1880	298,000	161,000	1885	540,000	74,000
1881	320,000	161,000	1886	682,000	139,000

From the statistics published by Mr. F. O. Licht, I give the following figures:—

TOTAL PRODUCTION in 1886.

							Tons.
Cane sugar	..	..	..	..	..	..	2,247,000
Beet sugar	..	..	..	..	..	..	2,620,000
							<u>4,867,000</u>

For the total consumption of the world, no reliable figures can be given. That of Europe and North America has been estimated at:—

							Tons.
Europe	..	..	..	..	..	..	2,549,029
North America	..	..	..	..	..	..	1,028,429
							<u>3,577,458</u>

The production of beet sugar in 1886 exceeded that of 1885 by about 500,000 tons. It even surpassed the large crop of 1884. This enormous increase was due to the protection unwisely granted to this branch of agriculture in nearly every country.

Austro-Hungary.—The number of factories declined from 232 in 1883, to 212 in 1886. In 1885, the quantity of beetroot used was 4,340,190 tons, and the sugar exported 370,459 tons, on which a drawback was received of £2,764,272.

There were, in 1885, 367,457 acres under sugar beet in Austria, and 94,732 acres in Hungary.

Russia makes about 538,000 tons.

France.—There were in 1885, 478,306 acres under sugar beet, the yield being 107,919,200 cwts. of roots. The number of factories declined from 521 in 1876, to 391 in 1887. The quantity of beetroot used in 1886 was 3,400,000 tons, and the

sugar made, excluding molasses, was 265,071 tons, of which 139,856 tons were exported.

Belgium.—In 1888, there were 80,589 acres under sugar beet, which produced 17,160,786 cwts. of roots. The number of factories is 113, a decline of 50 or 60 from ten years previous. The raw sugar produced was about 95,000 tons.

Holland has about 53,000 acres under sugar beet, and Sweden produces about 800,000 cwts. of beetroot, the sugar made by these two countries being about 37,500 tons.

German Empire.—The present number (1887) of factories is 401, the largest number, 312, being in Prussia, after which come Brunswick and Anhalt with about 30 each, and the other smaller States with from 3 to 6 each. The quantity of beetroot worked on in 1886 was 8,306,671 tons, from which nearly a million tons of sugar were produced, besides molasses. The sugar duty paid was over £7,060,670. The exports in 1885 were 673,727 tons, on which a drawback was paid of £5,656,253.

The exports of raw beet sugar from Germany (the Zollverein) have been as follows:—

	Tons.		Tons.
1877	44,903	1882	289,771
1878	99,347	1883	436,789
1879	105,431	1884	524,662
1880	197,835	1885	444,205
1881	252,088	1886	452,192

The shipments in 1886 were to the following countries:—

	Tons.
Sweden	7,933
Hanse Towns	73,520
Holland	52,897
Belgium	1,418
United Kingdom	288,599
United States	24,552
Other countries	3,273
	452,192

GLUCOSE, OR STARCH SUGAR.

There is another description of sugar now manufactured largely, which has to be taken into consideration by the sugar planters, as it is used a good deal in brewing, by confectioners and others, and that is glucose or sugar made from potato and other starch. The quantity manufactured in Germany is large. There are 717 factories, and these made the following quantities of sugar in 1876:—

	Cwts.
1. Solid glucose	116,109
2. Molasses or syrup	220,452
3. Coloured starch or caramel	21,017
Total	357,578

In 1880, 29,000 tons were made, and with the imports 54,000 tons were exported.

The cultivation of potatoes, for the purpose of obtaining their starch, covers a large extent of territory on the Continent. The method pursued in nearly all of the refineries is identical. The wet starch is first put in a large mash-tub, where, under constant stirring for an hour, it is entirely dissolved in water and dilute acid. From the mash-tub it is run in vats, where it can be boiled by steam; here it remains, if for sugar four or five hours, for syrup two or three hours. It is then put into the neutralizing tanks, to be treated with carbonate of lime, and left until the sediment, chiefly composed of gypsum, has settled—this usually requires six hours. The sweet liquid thus obtained is evaporated in vacuum pans, filtered, and left to crystallize, if sugar is to be made, or is else manufactured into syrup.

In the United States a large quantity of glucose is made from maize. The idea was first introduced to notice there in 1867, and now a large portion of the Indian corn crop is used in making glucose. The product is surreptitiously mixed with cheap brown sugar, whitening it up to a higher-priced white grade; and the syrup, either mixed or unmixed with the true saccharine article, is palmed off as genuine cane or maple syrup. The profit from this underhand business is large. A bushel of corn is said to yield 30 lbs. of grape sugar, or three gallons of the syrup, and while the sugar costs only $3\frac{1}{2}$ cents per lb. to make, it is sold at 7 cents, the syrup being quite as valuable.

The Chamber of Commerce of New York, in its annual report, expresses the belief that the output of this sort of sugar is now not less than 1000 tons a day for the whole country, and that in New York the glucose manufacture is interfering seriously with the legitimate importation from the West Indies, &c. At Chicago, commanding as it does the corn region of the West, glucose is made largely, and a new factory about to be started there is to consume 15,000 bushels of corn per day.

The great increase in the vine-growing districts of America has occasioned an enlarged demand for glucose, and the manufacture of this article appears destined to assume very large proportions in the United States, where Indian corn can be obtained in unlimited quantity at a very low price.

The manufacture of starch sugar has been long known in Japan. Millet and rice are used for the purpose, and after being steamed, they are mixed with a certain quantity of malt or ferment, and kept for several hours at a fixed temperature in closed vessels, after which the liquid portion is strained, and concentrated by evaporation to a strong syrup, or a solid mass, which is formed into bars while still hot. It is called Ame, and constitutes a kind of confectionery.

SORGHUM SUGAR.

Attempts have been made from time to time to introduce and extend the cultivation for sugar of a species of millet or sweet cane, the *Sorghum saccharatum*, Pers., *Andropogon saccharatus*, Roxb. This grass, allied to the *Sorghum vulgare*, or Dhurra plant of North Africa, and the Guinea corn of the West Indies, is grown in the north of China for the extraction of sugar. In New South Wales it has been found to stand frost better than the sugar-cane proper, and is little affected by floods. It comes to maturity in five months, and therefore may be employed as an interval crop, alternating with sugar-cane, and keeping the sugar mills going. When not grown for sugar, the plant yields abundance of valuable food for cattle, at the rate of 30 to 40 tons of cane per acre.

In France M. Vilmorin states that it is capable of yielding on an average, from an acre of land, 26,000 lbs. of juice, containing from 10 to 13 per cent. of sugar; and that this is more than the average yield of the sugar beet. It is alleged, however, that the plant is adapted to only a few parts of the south of France.

Mr. Leonard Wray asserts that some of the varieties of Sorghum which he introduced from Natal gave 30 cwts. of sugar per acre, that it has yielded from a poor handmill 68 per cent. of juice, containing 15 per cent. of sugar. Where the sugar-cane has yielded 30 it has given 25, but then there is often a second and a third crop to be obtained within the year. This plant can in many localities be advantageously utilized for preparing treacle. For this purpose the sap is expressed at the time of flowering and simply evaporated; the yield is about 100 gallons from the acre.

It is grown in France and Algeria for alcohol chiefly, in Italy for its syrup in wine-making.

In the North-western States of America where it flourishes, there were, in 1864, 366,670 acres under sorghum, and sorghum sugar was selling at Chicago at $4\frac{1}{2}d.$ per lb. In 1860 nearly 7,000,000 gallons of sorghum treacle were produced in the United States. This had increased in 1870 to 16,050,089 gallons, and 24 hogheads of sorghum sugar were made.

In the State of Kansas there were 23,026 acres under sorghum in 1875. The produce was 2,542,512 gallons of syrup.

In 1876 it was estimated officially in the United States that the production of sorghum syrup was 11,000,000 gallons annually, worth about 7,000,000 dollars. In Ohio 506,000 lbs. of sorghum sugar were produced.

The grain is altogether valueless in a country where maize is grown so universally, and yields such an immense produce. Hence the plant is grown principally for syrup, of which in 1883 some 30,000,000 gallons were extracted.

The Champaign Sugar Works, Champaign, Illinois, were the first large sorghum sugar works ever started in the United States.

They have ground the stalks raised on about 1000 acres of land, and the result is a perfect success in the way of making a first-class quality of sugar that polarizes 98 degrees, and much sweeter than sugar made from cane or beetroots. For years experiments have been made to find out some way to change sorghum syrup into sugar. The attempt was unsuccessful until lately, when the State of Illinois offered a bounty to any one who would succeed in granulating the syrup into sugar. Experiments made at the State University of Illinois, in Champaign, by Professors Weber and Scovell, succeeded in accomplishing the result. A ready sale is found for all the sugar and syrup made, and the success there will cause a large number of sugar works to be erected all over the West, for sorghum cane will grow where corn can be raised, and where farmers can make \$15 an acre in raising corn, they can realize \$30 an acre in raising sorghum cane to sell to these factories.

The result of this discovery is likely to make as great a change in America as the making of beet sugar has in Europe. The Champaign Sugar Works have introduced all the modern improvements. The machinery, boiler, and vacuum pans were made by the Atlantic Works in Brooklyn, N.Y. They use both the Weston and Hepworth centrifugals. The refuse stalk called "bagasse" is carried on conductors directly from the grinding mill and dropped into the furnaces in its green, wet state. The boilers are set with the Jarvis patent furnace, and hot air is discharged directly over the fires, igniting the gases generated by the burning fuel. The intense heat made by joining the gases with hot air is said to cause the green crushed cane or bagasse to burn very well, on something the same principle as tanners burn their wet bark from the leaches.

The Jarvis furnace is now in successful operation in the islands of Cuba and Santo Domingo, Guatemala, and the Sandwich Islands. In the West Indies the bagasse has to be dried before using. In the United States, at New Orleans, and the West, much of this material has heretofore been thrown away, and coal or wood used for fuel, because, although the wet bagasse could be burned, but few of the sugar manufacturers would use the improved furnaces necessary.

Sorghum is cultivated to a considerable extent in the Ohio belt of counties, Western Virginia. It is used entirely for the manufacture of molasses for home consumption, where the locality has been more or less denuded of its maple trees. Most persons prefer the syrup prepared from the maple to the molasses from sorghum, as the latter has too commonly from imperfect ripening an acid taste. This cane succeeds well, and in good soil, when well manured, yields from 200 to 300 gallons per acre. The total production for the State of West Virginia was given in 1876 at 780,829 gallons.

The chief merit of the sorghum is, however, as a forage plant, and its value for feeding stock cannot be surpassed by any other crop, since a greater amount of nutritious fodder can be obtained by it in a shorter time, within a given space, and more cheaply.

It cannot be propagated by cuttings like the cane, but ratoons when the stems are cut down.

Dr. P. Collier, the chemist of the Department of Agriculture, Washington, examined in 1880 thirty-eight varieties of sorghum, grown in and received from fourteen different States, and nine varieties of Indian corn. The results of analyses made (1318 in all) of the sorghums, showed them to yield on an average 1662 pounds of available sugar. From four of these varieties, the sugar was extracted in quantity and at a rate of fully 2000 pounds per acre.

In the earlier stages of growth the amount of crystallizable sugar (sucrose) is small, but as the plant matures the sucrose rapidly increases, until it equals from 12 to 16 per cent. of the juice. The "solids not sugar" in the juice also increase from the first, but very much less rapidly than does the crystallizable sugar. At the same time the uncrystallizable sugar (glucose) steadily diminishes, so that the purity of the juice increases constantly until the cane is ready to be worked. Aided by Government grants, these experiments were reported so successful in 1887, that they have, "it is confidently believed, placed sorghum sugar-making among the profitable industries of the country."

The State of Kansas has been the first to demonstrate that it is practicable to extract sugar from sorghum. Mr. Fisher, the British Consul at Chicago, in an official report published in 1888, states that the experiments show that, taking $7\frac{1}{2}$ tons of clean canes as an average yield per acre of land cultivated with sorghum (and good cultivation can increase the yield to 10 and even 12 tons), this will produce 700 lbs. of sugar, 1000 lbs. of molasses, 900 lbs. of seed, 1500 lbs. of fodder, and 1500 lbs. of exhausted chips (dried), and that the total value of sugar, molasses and seed is about £1118. For the corresponding gross yield of 10 tons of sorghum at 8s. per ton, the farmer will make £4 per acre for his crop, or more than double the yield of a crop of wheat or maize, while as a gross product of agriculture and manufacture, it is said that six times as much per acre will be realised from this industry as is usually realised from cereals in the State of Kansas. Sorghum seed is said to be of about equal value with Indian corn for feeding purposes. Mr. Fisher describes in detail * the working of one of the experimental factories during 1887, and the various processes through which the cane goes.

The farmer's part is the most important of all, and it is thought that much may be done by experiments to improve the canes, on the same principle as beet for sugar has been improved, by careful nursing, producing different hybrids, and preserving seed only from such cane as has been shown by analysis to contain the greatest amount of sugar. It is also thought that the length of the season for working sorghum may be extended by the development of earlier varieties and by cultivation.

* Miscellaneous Series of Reports to Parliament, No. 83.

In 1888 at one manufactory at Fort Scott, Kansas, there was made:—

500,000 lbs. sugar at 5 cents.	..	..	..	..	..	..	\$	25,000
100,000 gallons of syrup at 20 cents.	..	..	..	..	..	..		20,000
The State bounty at 2 cents. per pound	..	..	..	..	..	..		10,000
Making a total receipt of	..	..	..	..	..	..		<u>55,000</u>

MAIZE SUGAR.

At the time of the Continental War, when France and a considerable portion of Europe was deprived of colonial produce, attempts were made to undertake, on a grand scale, the manufacture of grape sugar, and experiments were made with different plants in order to obtain sugar; the maize was one of these, and Parmentier pursued his researches in order to extract sugar from it; this, however, he only succeeded in doing in the form of non-crystallizable syrup. These researches are set forth in his work 'On the Manufacture of Syrups,' which bears the date of 1813. Ten years later, Marabille of Pavia, extracted sugar from the maize; then came Burget, Deyeux, Pietet (1821), Dr. Neuhold, Pallas (1824), Biot and Soubeiran. But no part of these experiments established the fact that a really crystallizable sugar could be made from maize; syrup only was extracted. In 1842 some experiments were made in Louisiana, which clearly proved that the sugar corn contained a large portion of crystallizable sugar, but the extraction seems to present great difficulties. At what particular period in the growth of the plant the sugar is crystallizable and what quantity can be practicably extracted from it, is the important point not yet resolved.

An average of twenty-six analyses of nine samples of maize, made by Dr. P. Collier, of Washington, in 1880, showed them to contain in their juice an amount of sugar greater in quantity than the average of the best thirty of sixty specimens of sugar beet grown in different parts of the States. After a large crop of ripe corn had been gathered, the stalks yielded at the rate of over 900 lbs. of sugar to the acre, and there appears no reason to doubt that this result could be obtained upon a larger scale.

SECTION II.

THE USEFUL PALMS, AND THEIR ECONOMIC PRODUCTS.

THE number of known species of palms is over one thousand. Although chiefly natives of tropical regions, we may learn from Von Martius's great work that there are many extra-tropical members of this princely order which were known to him in 1850, when that masterly work was concluded. Several of the latter furnish useful products to commerce, such as the dwarf palm (*Chamærops humilis*).

There is scarcely any family of trees that are more generally useful in tropical climates than the palm tribe. Many a single member of this family has numerous special and important economic uses, rendering it invaluable to the natives. Some palms are very widely diffused over the globe, others are at present restricted to certain countries, but there is no reason to doubt that by a little careful management several of the most useful could be introduced and acclimatized in other quarters. Numerous races depend almost entirely upon the palms for many important products; wood and leaves for habitation, bark and leaves for fabrics and cordage, buds and fruit for food, and sap for sugar and spirit. With the view of diffusing practical information concerning their growth and useful products, I furnish such information concerning principal palms as I have been able to collect.

THE COCONUT PALM (*Cocos nucifera*) is one of the most useful trees of tropical regions; all its parts are utilized, but its fruit is the most important product. In preparing plantations, the nuts for sprouting should be chosen from those thoroughly ripe, having full, large eyes, and such as have been gathered from trees past the middle age—not, however, from aged ones—and from clusters containing few fruits. These, if carefully planted, are said to ensure the timely sprouting and steady growth of the plant as well as future luxuriance, longevity, and unintermitting fruitfulness. Such nuts as are gathered from February to May are generally the richest in oleaginous properties, and hence should be preferred. Nuts taken from older trees have the eyes small, and the sprout will in consequence be thin, weak, and disproportionately long; and the future tree, if able to bear fruit, irregular and deficient in

produce. Those nuts which may be taken from trees of immature age will, if planted, rot away at the eye; and the plants, if any be successfully reared, on transplanting will grow very rapidly and acquire bulk, but the fruit will drop before the kernel acquires consistency, the root stalks break, and the trees entirely fail before mid-age.

The nuts for seed should not, on being gathered, be allowed to fall to the earth, but be lowered in a basket or fastened to a rope. If let fall, the polished cover to the fibres will be injured and collect damp about the nut, or the shell inside may be cracked, and the water disturbed. These are fatal injuries, for even if the plants still grow, they will on being transplanted not make fresh shoots, but produce weak trees having their fronds constantly drying up, nuts rarely matured, and often even without kernel in those which appear perfect. If the nuts are allowed to dry on the tree before gathering, the plants are liable to be lost, not having water inside to cherish the growth of the sprout (before the actual roots shoot into the soil).

The seed nuts, after being gathered, should be carefully kept for not less than a month before they are planted (in order that some of the moisture be absorbed, and the hard outer skin or rind be rendered dry and waterproof). If the seed be immediately planted, the outer pod with the containing fibres will rot, and there will be no sprout. The eye will rot, or be a long time sending out the shoot, which will inevitably produce a weak, profitless plant. On the other hand, should a longer time intervene between gathering and planting seed than prescribed, the capsule of the fruit will fall off, and consequently the exposure to damp and rain will affect the eyes; there will then be no plants, or very indifferent ones. The seeds should be planted on an elevated plot or bed of land, where water will not stagnate. The plants will be strong if the nuts are placed on the hard sandy courtyard of the planter's dwelling-house; or if placed in flower-pots with good soil and sand in them, no damage will be done by white ants, and very few will fail to germinate. If, however, they are placed on a hard soil which the roots cannot penetrate, and exposed to the sun, the water inside will dry up, damage will be done by ants, and those few that throw out shoots will be weak, and on transplanting, the roots will break and the sprouts be severed from the nuts. If, on the other hand, they are deposited on uneven ground or too moist soils, both the fibrous covering and the eyes will rot, and the seeds come to grief.

Nurseries should be somewhat exposed to the influence of the sun, though not too much heat; plants thus grown will, even though deficient in stature, be strong, and when transplanted will not fail nor suffer from heat. Should plants, however, have but little sun, no great harm is done; but if they be grown entirely under cover, insects will infest them, the stems will be long, tapering, and weak, the fronds will be often unable to sustain their own weight, and when transplanted, each successive hot season will affect the trees.

The planting of the nuts should take place from January to April, and also in August, provided the rains are not heavy, and then the planter may expect fruitful trees to be produced when grown; but nurseries formed during the heavy monsoon will generally fail, or produce trees which will yield small nuts. Too much moisture of every kind is injurious to plants.

The seed beds, where the plants are to be nursed, should be well dug to about two feet deep, and all stones, roots of trees, &c., removed; the coconuts should then be laid along flat on their side in the soil, in such a way that all but two inches of them be buried, the interval between the nuts being about a foot at least. Should the spaces be too great, the plants will have too many roots, and the sun will not be shaded from them by the fronds, which will be shown by the pale green of the leaf. But should the nuts be placed too close to each other, the young shoots will be then meagre and quickly spindle up; the roots too will twist together and be broken when the plants are taken up to be transplanted. Though manuring is of little use before they have taken root, yet in order to prevent white ants, &c., a mixture of salt and ashes, or ashes alone, should be put into the trenches made in the beds for receiving the coconut. Sand alone, or salt with ashes, sand, and paddy husk, form another mixture to be placed between the earth of the bed and the nuts, which latter should be covered with the compost. Black salt, ashes made from the coconut husk and fronds, with sea sand, is the best mixture. If this precaution be not used, many of the nuts will be injured and the plants grow pale and weak.

The next care is to water the nursery, which should be done only every second or fourth day according to the dryness of the weather, simply keeping the soil moist; for if the ground is too damp, rot is engendered, but if too dry the coconut water inside the nuts will evaporate and the shoots dry up. A careful observance of these instructions will cause the shoots to sprout generally within six months from the time they are placed in the ground.

Some place the coconuts intended for seed, tied together in pairs by a strip of the covering on the cadjan, over the roof tree of the dwelling-house, or on branches of jack trees, freely exposing them to sun, dew, and rain. But when the shoots are a few inches long, they are taken down and placed in a nursery till transplanted. Such plants are seldom lost, and make no great delay in yielding fruit. Once the tender shoots begin to appear, no great care is necessary for manuring, but the greatest attention should be given that no cattle or insect, &c., injure the shoot itself, else the slightest blow or abrasion will cause a want of vigour; but on the other hand, some suppose that unless either ashes alone, or mixed with salt and sand, or these separately, be applied to the plants every month, a want of colour will be visible in the opening leaves, or ants and other destructive insects will be fostered. Plants are removed for transplanting generally in the second or third month, sometimes even in the ninth month, but rarely so late as the fifth month;

but in ordinary cases, if they be transplanted six months after the shoot makes its first appearance, their safe growth and vigour may be looked for. In low-lying lands, however, it is preferable to have plants of one year's growth, though they are more difficult in managing. The only benefit to be expected in transplanting older plants is that the planter looks for an earlier return, and in planting these on the banks of the rivers or low lands formed from the wash of the monsoons, the crops will not be deficient. Plants left too long in the nursery and then removed are apt to have the fibrous supports at the foot of the fronds decay, so that these hang down, wither, and dry up, and new fronds and leaves do not make their appearance for four or more months, and these generally die prematurely. Some of the planters give it as their opinion that the transplanting may be effected from January to May, and again in August, October, and November (*i.e.* omitting the wet months). Perhaps, however, the general rule should be, that in low, damp situations planting may be effected during the hot season, in salt marshes and on hill-sides during the monsoon. It is said that those trees planted from January to June will yield fruit for eight months in the year, and those planted in October for six months, while those planted in June and July in the heavy rains will scarcely be fruitful at all. Different places and soils require different seasons for this operation, to be learned only from experience or observation of neighbouring gardens. Soils suitable for a coconut plantation are variously described as below, particularly observing that stony grounds, or those overlying rocky foundations, are to be avoided:—

1. Soils mixed with sand, either dark-coloured or river-washed.
2. Where sand is mixed with clay, ferruginous earth, or black mould.
3. Clayey soils where the under strata consists of sand.
4. Sand and clay, even when mixed with gravel and pebbles.
5. The sea-shore, banks of backwaters, rivers, tanks, and paddy-fields.
6. Alluvium of rivers and backwaters, provided a yard and a half of land is to be generally seen above water level.
7. Marshy land even in brackish soils (but not where salt is formed in crystals by evaporation).
8. All level lands exposed to the sea breeze where the soil is good, as the valleys between hills, tanks, and ditches which have been filled up.
9. Lastly, even the floors of ruined houses well worked up, and any places much frequented by cattle and human beings, on account of the ashes and salts of ammonia from the urine, &c., deposited day by day in the soil.

Sunlight is most beneficial to the coconut tree; it increases the number of successive fronds and the crops of fruit, while if much shade is caused by trees of other kinds, there is a tendency in the lower part of the coconut stem to thicken, while the upper part grows thin and attenuated, with fronds at considerable intervals and little fruit.

Exposure to regular breezes is also beneficial, for the constant movements of the tree tops have a tendency to strengthen and enliven the whole tree. The difference is easily seen by comparison with those in sheltered positions. The holes or pits into which the plants are to be transplanted should be severally 12 yards distant on backwaters, but where a deep alluvial soil is found, 8 or 10 yards are enough. These distances are necessary, otherwise the trees, not having room to expand their tops, repel each other and grow in diagonal positions, and are easily blown down or overset. Too close a neighbourhood also tends to draw up the trees into long feeble stems, shoots, fronds, and small fruit. In a level, loose soil the hole should be a cube, of a yard and a half, on hill-sides 2 to $2\frac{1}{2}$ yards, but in low grounds half or three-quarters of a yard deep with one yard square is sufficient. If the pits are not wide and sufficiently deep, the roots soon appear above the surface of the surrounding ground, and the hold upon the earth is weak, nor is sufficient nourishment obtained, and the monsoon storms quickly overturn the tree where the soil is marshy, though the hole need only be large enough to contain the seed and roots, and in a cold clayed ground the holes are filled with sand and the plants deposited in it. Again, in low marshes, banks or terraces should be thrown up and consolidated previous to planting. If in any of these cases plants of two or three years old are used, the pits must be at least $2\frac{1}{2}$ yards every way. The pits should be dug from two to six months before planting, and then prepared first by having heaps of fuel and weeds burned in them, and subsequently by manuring. The fresh earth is supposed to be full of ants and worms, and itself injurious to the new plant, and to hinder growth; on the contrary, there are some planters who deny this statement and think the burning and manuring not to be necessary. In low-situated plantations new holes may be preferred and quick planting. No time should be lost in the removal from the nursery to the pits, indeed the day should not pass—in which case within the month new roots and fronds may be looked for; but where this proves impracticable, if the plants are kept cool and in shade, four to six or eight days have been known to intervene, but followed by very great loss in the number of successful trees. Inside the pits smaller ones should be made and filled with salt and ashes mixed with mould, into which the young plants are to be planted, with the nuts just covered with this compost. Some shade must be afforded, and care taken that the plants be not shaken or removed from their first position, and occasionally water should be sprinkled over them. The compost must be used when there is but a small proportion of sand in the soil. Ashes will suffice on the sea-shore, and sand in marshy and loamy soils. The roots of a plant under a year which are broken (but according to many planters all found on the nuts in the nursery) should have their ends cut, as new ones are supposed to be hastened by the process. Turmeric and arrowroot are often planted in the same pits with the coconut, as they are supposed in some way to repel white ants, rats, &c. After the plants are in, little sheds with

twigs and branches should be made to protect them for the next six months from too great heat of noon-day sun; this prevents withering of the leaves or any check to the growth of the roots.

On dry soils the plants ought to be watered twice a day for the first month, once a day will suffice for the next five, or until the moonsoon showers come on, and once every two or three days during the dry seasons of three following years, according to circumstances. On hill-sides it is usual to water during the hot weather, even till the first buds appear; and on sandy plains on the sea-coast, when the trees are in full bearing, eight or ten feet of bamboo (with the divisions at the joints broken to form the pipe) is often driven down by the side of the coconut tree, and cool water from weed-covered tanks is poured down to refresh the roots and lower soil. The soil round the young plant is often kept damp by a bed of leaves, particularly such as will not be eaten by white ants. If the soil is naturally poor or of a hungry nature, salt, ashes, paddy husks, goats' dung, and dry manures may be applied for the first year, but in after seasons, fresh ashes, decayed fish, carrion, or other refuse is preferable, also oil-cake.

If the soil at the foot become too rich, the larva of a beetle, a large grub with a reddish-brown head, soon finds its way to the roots and into the stem, hence though the foot of the tree may enlarge, the stem does not develop itself, the new leaf-spike at the crown becomes yellow, fades, and is not replaced, nor does it open out into the usual frond, and in two or three months, sometimes a little longer, the whole tree top is affected and drops down piecemeal to the ground. It would appear that fear of this evil is the reason why ashes alone are recommended by so many cultivators.

As soon as the new fronds have divided into the long side leaflets or lost their connected form, which is at the end of the first year, the soil should be dug up and ashes applied about once a month. When the tree is two years old, and henceforward at the commencement of every monsoon in May and June, the whole of the soil, a yard or two round the stem, must be opened out and ashes with dry manure applied and left open to the air; and in October, when the rains have ceased, this freshened earth should be replaced and levelled. As the tree gets older and the depression at the foot is gradually filled up, it may not in after years be necessary to dig so deep as for the earlier growths. If the opening out of the roots and manuring be thus annually attended to, the tendency to form a sort of bulb on the surface and throw roots above the soil will be checked; the old worn-out rootlets are cut away, strong roots from other trees and all weeds are removed, and the process acts both as "a wintering and pruning," as recommended by scientific gardeners in Europe to productions of their own gardens. Cattle are most destructive the first two years, in eating off the ends of the fronds and stripping the leaflets; if the plants suffer often in this way, the growth is entirely stopped; sometimes the new leaf-spike is pulled out, and the tree dies. Should the heart

of the stem and top not be injured, the tree will still remain an unsightly object, and often entirely profitless and barren.

From the time that the leaflets become fully developed and distinct from each other, till the period that the spathes (or covers to the flower) make their appearance, the fronds should be shaken and weighed or pressed downwards each month, so as to keep them from each other and make them spread, and careful examination should be made lest rats, beetles, or worms have made nests upon the head, or bored into the cabbage heart of the palm, and this often. Some planters sprinkle ashes and salt about the spike shoots to keep insects away. The dried fronds, old spathes, fruit and blossom stalks, and ragged fibres should be removed at stated periods of perhaps a month, or as often as the nuts may hereafter be gathered. The application of salt and ashes to the tree tops is usual at least in March and October to keep off the swarms of insects, particularly red ants, which live upon the juices of the tree and render them fruitless.

Distinct leaflets will begin to show themselves at the end of the first year, and be completed at the end of the second, on each frond, which will be 3 inches thick in the stem or leaf stalk next the parent trunk.

In the third year the bottom of the frond will assume somewhat the form of a horse-shoe where it clasps the main tree; and in the fourth year the trunk of the tree will appear slightly above ground, and is then called "a coconut tree with the elephant's foot," and will have not less than twelve fronds. About the fifth year the trunk is fully manifested, and there should be about twenty to twenty-four fronds; when a luxuriant well-grown tree begins to bear fruit, there will be no less than thirty-six of these branches or fronds. If a tree receives much attention, and is close to a hut or stall for cattle, these processes may be hastened, but on a rocky hillside they will be much delayed, two or more years being required in addition to each stage.

Spathes or shoots, from which eventually the flowers are to appear, will begin to make their appearance in the sixth year, but some kinds of coco palm, as the Nicobar, even before this; but on other soils seven to fifteen years may pass without the slightest appearance of the spathes. The height of the stems at this important period, in some kinds of tree usually, and in all when influenced by the soil, will be only a foot or two above the ground, while in other places the stem may be 16 feet high. For the first few months these flower shoots are deceptive, and only dry up, but within the year begin to retain their blossoms and bear a few fruit, yielding abundantly in three or four years after their first appearance.

In six months from blossoming the nuts will have the kernel begin to solidify, and in a year the fruit is fully ripe—even sooner if the season is very hot and dry.

The produce of the tree in full health and properly tended is much dependent on soil and climate. The average may be put down at 120 nuts in the twelve months, while in a low and sandy soil it

will amount to 200, and when planted in gravel and laterite foundations, not 60; the most productive months are from January to June, that is for ripe nuts, the heat bringing them quickly to maturity.

It is calculated that where the roots of the trees can reach water, and the soil is alluvial, the trees will bear from eight to ten bunches or crops of fruit; in other and higher lands not more than six.

One hundred coconuts perfectly grown and carefully dried will, it is generally calculated, yield when pressed ten to thirteen edangalies (each containing 92 cubic inches) of oil (40 nuts to an imperial gallon). Inferior coconuts will vary from three to nine edangalies; fruit taken from trees on salt marshes have the least oil.

When the trees begin to show the fruit-shoot, or spathe, it is often thought advisable to extract the juices for toddy, and not allow the blossoms to be grown; but this only in the monsoon, and for that season only. This is supposed to render the future fruit bunches more numerous and give the sap a tendency to flow. In some places trees are never allowed to bear fruit, but toddy is always extracted. Drawing toddy for a few months is thought to check the habit in some trees of dropping immature fruit, and again of preventing injurious animals and insects from infesting plantations, the frequent visits of the men to the trees being a check to their forming nests and otherwise remaining hid in the tree tops.

While certain of the fruit-shoots are cut for toddy the others will still produce coconuts, as well as those previously developed; but if three or four be used for this purpose, the others will dry away or be of very little use. Even when a spathe is partly used for toddy and left, provided the part containing the buds remains undestroyed, a few fruit may be produced on that stalk.

Five parras, of ten edangalies each, of good arrack may be made from a single tree devoted to this purpose during a single year; but some very good trees will give, though rarely, eight to ten parras.

Gathering some of the tender coconuts from the earlier bunches will develop the succeeding bunches greatly, and strengthen the whole tree very materially. It is not, however, recommended to cut the fruit stems or stalks out before they are matured and dry, as it causes the tree to bleed and lose its most valuable juices; hence, in order to prevent the possibility of injury to the tree, owners should permit none but mature fruit to be taken.

The number of fronds which dry and fall off from a tree is eight or ten in the course of the year, principally in the hot season. It is usual to cut these off, but if done too early, those next the one cut are affected and fade; hence only those turning brown should be removed, and leaving a small portion of the foot stalk on the tree. It must be remembered that the drooping leaves are intended to protect the tree stem from the burning sun.

Thirty species of the coconut are described and named in the

East as in the subjoined list; but cultivation and incidental natural causes have much to do with this diversity, and in a few cases these are but imaginary distinctions:—

Names.	Description.
1. The green coconut ..	The fruit and fronds are of a bright green.
2. The black or dark ..	These are of a dark green.
3. The native	The fruit has a yellow tinge.
4. (a) Goulpatra	This name is given to what is supposed to be the best kinds, one variety yellow and the other a light brown or light colour, and of beautiful form.
5. (b) Ditto	
6. The reddish coconut	The nut has a strong red tinge.
7. The red ditto	Is brighter than the last.
8. The crimson	Even the pulp and fresh fibres of the husk round the nut are pink, and the fronds are reddish.
9. The sunbright ..	The nut has a beautiful fading blush, the fruit being small in size, but numerous.
10. The white	The nut and fronds have a grey bloom.
11. The milky	The pulp is creamy and thick.
12. Oblong oval	The fruit is long, and the ridges well developed.
13. The Tanjore	The nut is long and pointed, with a large base.
14. The Oora	The nut is pointed at each end, and oblong.
15. The globular	The bunches contain many large round fruit.
16. Small round	Fruit more numerous, but also very round.
17. Minute coconut ..	A diminutive fruit, but made up by number.
18. The weighty coconut	Fruit large, but large and heavy, with thick kernel.
19. The heavy ditto ..	The eyes of the fruit are small, but the copra or dried kernel is very full of oil.
20. Male coconut	There is a peculiarity in the fronds, and the leaflets do not separate from each other.
21. Foreign coconut ..	Evidently from the Maldives; both the nut and fruit-stems reddish.
22. The island coconut	
23. The Portuguese ..	The same as above.
24. Shanar or Ceylon ..	Nut large and red, fronds slightly bluish.
25. The Dutch	Fruit, &c., a pale red colour.
26. The Goa	Two fruits only on each bunch, and these dark green.
27. Jaffna coconut ..	Here again the fruit is large, but few in number.
28. Palameotta	The fronds of this tree are pale yellow.
29. The ship coconut ..	Stem or trunk of the tree and leaves small, and all tinted with black spots as if blighted.
30. The Maldiva	The covering of the fruit is of a whitish or washed-out blue.

The red and black kinds are generally supposed to be the most fruitful, although with careful cultivation of any of the above described, none need be disappointed in the returns, and this will be in proportion to the labour bestowed.

Trees growing in the most fertile soils will live for a century, others less favoured from sixty to eighty years only; the former will yield their fruit commencing at the tenth year, and with rare intervals continue until their sixtieth year, and then gradually decrease in fruitfulness till they decay.

Although its real locality is bordered by the tropics, and the tree is an inhabitant of the coast regions, it grows in India up to Lucknow, 26° 50' N., and is cultivated far in the interior of the peninsula, yet in the first case it does not fruit, and in the second it becomes stunted and languishes. Its tall trunk often attains a height of 90 feet, with a diameter of 3 feet at the base and 1 foot at the summit. In favourable localities each peduncle will bear from five to fifteen nuts, and a tree in full vigour may have eight, ten, or a dozen of these peduncles flourishing in the course of five or six weeks, so that a tree can yield 80 to 100 nuts in the year. These ripen successively, and there may thus be seen at the same time flowers and fruit.

From the fruit is obtained many articles of luxury and trade, thus, first, the husk. After the thick green external pellicle is stripped off the shell, it is placed to dry in the sun; this being fibrous, is beat into a sort of hemp, and is known in this state by the name of *Coir*. It is spun into cables, ropes, and yarn of every dimension and size, from a single pack-thread to a cable for a first-rate man-of-war; and it is preferable for ship's use, as it is elastic and becomes as hard as iron when tarred and soaked in salt water, but it is more unwieldy for stowage than hemp rope. Large quantities of it are annually sent from Ceylon, Bombay, and parts of the Malabar and Coromandel coast.

The albumen, or kernel, produces oil by boiling it in water, after it has been pounded or rasped. Grated, a sweet milk, used as a substitute for cow's or goat's milk, is obtained, and by various preparations, jelly, copra, butter, candles, and sugar are produced, and, by fermentation, vinegar. The oil it yields is used at table, and is equal in quality to oil of almonds when fresh; but it soon becomes rancid, and in this state is only employed locally by painters, or to burn in lamps. The natives of India use it in quantities for anointing their persons; it gives a fine gloss to the skin. A soap is also manufactured from it, which, with the exception of one prepared from the coratœ (*Agave Americana*), and discovered by Dr. Robinson about eighty years ago, is the only one known soluble in salt water.

The kernel is used as a fattening substance in the dairy, aviary, &c., and there is not any description of animal, graminivorous, carnivorous, or herbivorous, that does not feed on it with avidity. It is wholesome food for man, beast, and bird.

The milk of the coconut effervesces with an acid extract, and the acid precipitates in a greyish hue, which becomes of a rich violet colour by the addition of a fixed alkali. It is with this that most cottons are dyed. This emulsion mixed with quicklime causes the alkali to become rose-coloured. Dyers use this milk with great advantage in dyeing black linens, silks, and cotton stuffs.

The nut when it is gathered young contains an opaline water, which is quite clear if filtered, and is utilized for drinking. In countries where potable water is not obtained, only the milk or water of the coconut is drunk; it is an agreeable, nutritive, and

healthy beverage. The gelatinous albumen when young is easily detached from the shell with a spoon, and may be eaten with satisfaction. It is a delicate food, which is too little appreciated by Europeans, as it contains all the constituents of wholesome nourishment. As it ripens the albumen hardens and becomes almost horny, and the oil increases, although in this state it is still edible, but indigestible, and only eaten associated with other food. The following shows the composition of a young coconut and a ripe coconut:—

	Young Nut.	Ripe Nut.
Husk and shell	1·760	0·816
Kernel	0·090	0·434
Water	0·300	0·250
Totals	2·150	1·500

Coconut Oil.—Copra or copperah, the dry albuminous pulp, contains 54·3 per cent. of oil; dried at 100° it yields 66 per cent. This oil, which is the most important product, is prepared in various ways. If it is intended for perfumery use, and is required colourless, the following process is employed: The kernel is plunged in water and boiled for a few minutes, then taken out, grated and placed in the oil press; the emulsion thus obtained is boiled until the oil rises to the surface. This process, however, is not cheap enough for the ordinary practice of commerce, and common rude oil mills are used. These cost about £10, and will last for five years. They are worked by a man, a boy, and two oxen; working eight hours a day they will operate on 130 lbs. of copra, from which they will obtain 41 litres.

The characteristics for determining the purity of the coconut oil are its points of congelation and density. It solidifies at 18°. Taking the mean of the three following averages, the weight may be easily ascertained:—

Degrees.	Density.	Weight of Hecto- litre.
25	0·9188	Kilos. 91·880
30	0·9150	91·500
35	0·9116	91·166

Vast quantities of the oil are burned in lamps throughout the whole Indian Archipelago and the Pacific Isles. A tumbler half filled with water has oil poured in to the brim. Two lighted sticks are the wicks, which burn brilliantly. Every native glories in a display of lamps in the house and about the grounds at the approach of night. When first taken out of the boiling pot the oil has a rich flavour, but soon becomes rancid. So copious is the supply, however, it can always be had fresh and sweet^{er} for the

table. Like olive oil in Syria, it is butter, lard, or oil, according to circumstances, in cookery. Soap is made with it, lamps supplied, leather dressed, hair and skin anointed, and cosmetics are fabricated for beautifying the homely faces of women.

The following have been the imports of coconut oil in the United Kingdom in the last half century :—

			Cwts.				Cwts.
1840	..	..	42,428	1870	..	..	198,602
1850	..	..	98,040	1880	..	..	318,454
1860	..	..	194,309	1888	..	..	197,773

Oil Machinery.—The manufacture of coconut oil may be very profitably combined with the preparation of the fibre in one factory.

The following machines and apparatus are necessary for producing the oil :—

Improved circular cutting machines, for reducing the kernel to small thin slices or shavings.

Edge stone runners for grinding down the kernel to pulp.

Improved steam pans, fitted with agitators, so arranged that every part of the pulp or copra is thoroughly separated, and exposed to a temperature varying (according to operator's desire) from 120° to 180° Fahr., or higher if required. Valves, cocks, and all other suitable fittings for the discharge of pulp or copra.

Steam heater for receiving pulp from steam agitator.

Hydraulic presses for expressing the oil, specially designed for the purpose and of unusual strength, including plates and woollen bags and fibre mats, as may be required.

Pumps for presses, made in the most improved and superior manner, with all necessary safety and self-acting relief valves, cocks, and mountings, pressure gauge, &c. If required, one set of pumps and gearing may be arranged to work two or more presses.

Iron tanks for receiving the oil from the presses, of capacity to contain one day's make of oil. A gun-metal pump is employed for raising the contents to large settling tanks. These are generally made of cast-iron, in plates of a convenient size, and properly prepared for re-erection, with bolts, nuts, washers, &c.

The settling tanks should be of sufficient capacity to contain four days' produce of oil from the presses, and fitted with the necessary gun-metal test cocks and glass gauges, draw-off cocks, and valves.

The following estimate of machinery, capable of producing about 250 gallons per day, is furnished by Messrs. Priestman Bros., of Hull. In calculating production, 1000 nuts will average 32 gallons of oil :—

Two improved disc-cutting machines	..	..	..	..	..	£
Granite edge stone runners, with entablature, self-contained and complete	..	..	..	..	..	58
One improved steam pan, with stirrers and driving gear	..	..	..	..	..	168
Steam receiving pan	..	..	..	..	..	50
Two hydraulic presses, with double pumps, stop valves, and connections	..	..	..	..	..	29
	..	..	..	..	..	380

Connecting pipes, or oil conductors from presses to oil-receiving or spell tanks	£ 15
Oil-receiving or spell tanks, to contain say 400 gallons each, with fittings	36
Gun-metal lift and force pump, for raising oil to settling or storing tank	20
Large cast-iron storing tank, to contain 1000 gallons, with gun-metal cocks complete	86
Ten horse-power horizontal steam engine, of first-class make and finish, steam boiler, fitted with all mountings and furnace fittings complete, also steam and feed-water pipes and feed-water heater	330
Complete set of best shafting, with pulleys, plumber blocks, couplings and leather belting for the machines	80
Set of plates, mats, and bags for the hydraulic presses	60
Packing and delivery in London	50

If it is desired to erect a factory to manufacture both coir fibre and coconut oil, one engine can readily be adapted to work the whole of the machines. To drive the machines specified in the foregoing estimate, and also the coir-fibre machines, a 14 horse-power engine would be required for the combined arrangement. The engine, complete with Cornish boiler and all necessary mountings, fittings, and connections, all of best materials and workmanship, would cost £450. Packing and delivery in London, £10.

The coconut shell furnishes cups, which, carved and set in silver, are a great ornament. It also makes small baskets, ladles, spoons, and other such domestic articles, and fanciful ornaments. By being burnt and pulverized, and prepared with other ingredients, it produces blacking not inferior to Day and Martin's, lampblack, black paint, &c.

Coconut Fibre or Coir.—The fibrous husk of the coconut is not its least valuable product, and gives rise to a very large trade, both in the East and to Europe. At first it was only used in this country for stuffing mattresses and cushions, but its applications have been enlarged and its value greatly increased by mechanical processes; for in a small pamphlet, issued by Mr. Treloar, he states that its natural capabilities having been brought out, coir has been found suited for the production of a variety of articles of great utility and elegance of workmanship, table mats, fancy baskets, and bonnets. Instead of being formed into rough cordage only, and mats made by hand, by means of ingeniously constructed machinery, the fibre is rendered sufficiently fine for the loom, and matting of different textures with coloured devices is produced, while a combination of wool in pleasing designs gives the richness and effect of hearthrugs and carpeting. Brushes and brooms for household and stable purposes, matting for sheepfolds, pheasantries and poultry yards, church cushions and hassocks, hammocks, clothes lines, cordage of all sizes, and string for nurserymen and others, for tying up trees and other garden purposes; nose-bags for horses, mats and bags for seed crushers, oil pressers and candle manufacturers, are only a few of the varied purposes to which this fibrous coating of the coconut is now applied.

When the landholder gets his nuts down from the tree, they are

given over to be peeled. The peeling process is done in a very quick and dexterous manner by the natives. For breaking the nuts and drying the kernels, nothing is charged; but, according to the usage of the country, the breaker and preparer get the shells of the nuts. The husks, however, remain the property of the owner, and formerly used to be sold off for local consumption. But since coir yarn began to be so largely exported to England, it is seldom that the owners sell off husks as fuel, as they find that by burying them and then offering them for sale, they realise double the amount that they would when fresh. The best place for burying the husks is the river-bank where there are strong currents. At ebb-tide large pits are dug, and the husks counted and thrown in; and before the flood commences, they are covered up with mud, leaves, &c., and made quite secure. When the monsoon sets in, and the freshes come down, the pits are under fresh water, and from husks so rotted the best-coloured fibre is made. The reddish stuff known in the market as Codangaloid fibre is generally prepared from husks buried in places where the water is throughout the year saltish. The older the pits the better the quality of the fibre, and shrewd purchasers always bear this fact in mind when speculating in the article. Some years back the husks used to be kept in the pits for more than a year, but now they are not kept above six to eight months, for as soon as it is believed that they are rotten enough to throw out the fibre when beaten, they are removed. If kept above fifteen months, however, they spoil, and the fibre obtained is generally of a bluish colour, and of thin, poor staple, which is unsaleable in England. When a purchaser comes forward, the husks are either counted and delivered over, or, as is more usually done, the *cadjan* specifying the number buried in each pit is handed over and the bargain is supposed to be concluded. The stench emanating from the pits is often intolerable, and during the fibre season, travelling along the banks of the backwater is not a very pleasant thing. The purchaser hands over the husks to women, who beat out all the fibre with short heavy clubs; and as labour is very cheap in the interior, this process is not a very expensive one. They have to clear the fibre of all pith, wash it clean and expose it to be dried, and in a half-dried state it is bundled up and brought into market for sale. In Calicut and other ports on the Malabar coast, the fibre is prepared by a different process, and hence the very undesirable quality of the yarn of those places. In Cochin and Travancore the natives seem to be more alive to the importance of bringing the article to market in its best condition, as they find that it pays them to do so.

The constantly increasing demand for the prepared fibre is sufficient to induce many planters to cultivate largely the growth of the coconut.

The short, woody, and apparently intractable fibres lining the inside of the husk of the coconut constitute the material which Hindoo ingenuity had long since converted into excellent cordage. A quarter of a century ago this was its only use; now a large

industry has been created in it for matmaking and brushmaking, and we now import into the United Kingdom coir fibre, yarn, and cordage, to the collective value of about £300,000.

In 1845 under 10,000 cwts. of coir rope and fibre of all kinds were shipped from Ceylon; in 1870 it had increased to 58,000 cwts., and in 1886 to 82,000 cwts.

The pericarp of forty nuts furnishes about 6 lbs. of coir. There are several ways of stripping the fibre from the husk. One is by placing a stake or iron spike in the ground, and by striking the nut on the point the fibre is easily stripped. The tannin which this substance contains prevents the fibre from rotting. The fibre is rather difficult to twist, but coir yarn is made into ropes, and forms the strongest, lightest, and most elastic cables for ships. Before the husk is put into water to steep it should be well beaten, for the purpose of loosening its texture, principally that of the outer surface, which is hard and compact, so that the water may penetrate it with more ease. It is then left to steep for two or three days, and again beaten, until the separation is accomplished. Care should be taken that the husk is kept moist, because if allowed to become dry the ligneous fecula or spongy pulp, which is found intermixed with the fibre, adheres still more strongly to it. In some islands and parts of the coast where there are no running streams, holes are dug in the sand below high-water mark, and the husk buried several days previous to be being beat.

The separation of the husk is commonly done by tearing it off with the hands, aided by an axe. A simple application of the foot-power used in the common turning-lathe or knife-grinding wheel would enable one man to do the work at present the task of several. A double knife acting crosswise could be made to cut the nut and husk in two, and so prepare it for the extraction of the substance. Small, flat, pliant instruments would then easily extract the pulp from the shell of the nut, and leave it fit for the oil press.

About four days' maceration in fresh water is requisite. After this the husk must be beaten till the fibres separate, when it should be well washed, dried, and packed in pressed bales. For the purpose of beating it out, an instrument in the form of bars, somewhat in the form of a gridiron, should be used. It is obvious that this process might also be advantageously performed by machinery. One person can beat out with the hand, according to the age of the nut furnishing the husk, from 7 to 14 lbs. per day—say on an average 10 lbs., but by the use of proper instruments his work might be increased fourfold.

Machines.—The requisite machinery is simple in construction, and is easily worked by ordinary labourers. The following are required for the cleaning and preparation of the fibre, viz.:—

Tanks for soaking the fibrous husks, for “roller mill.”

Roller mill for straightening the husks and preparing the fibre for the “breaking-down” machine. This is made on the most approved design, with fluted rollers, self-acting adjusting blocks, and screws, wheel gearing, driving pulleys, &c., the whole complete and supported in a massive cast-iron frame.

Breaking-down mill, of improved construction, the revolving drum accurately centred on shaft, and fitted with best selected steel "spikes" (so arranged that, if required, any number of these "spikes" may be easily removed, repaired, and replaced), "feed" and "fence" motion, with wheels and hopper gearings, brush fence, and driving pulleys complete, all mounted on substantial cast-iron frame.

"Willy" machine, designed and constructed for receiving the fibre from the "breaking-down mill." This machine separates the different qualities of the fibre, and removes all dust, shorts, and refuse, leaving clean fibre. The machine is made in a very substantial manner, is self-contained, fitted with all gearing complete, and mounted on strong cast-iron frame.

Hydraulic press, for baling coir fibre for shipment, of the most improved design, and fitted with pumps and gearing complete.

Shaftings, pulleys, plummer blocks, bolts, leather belting, &c.

The following will be the approximate cost delivered in London of the plant, to clean say 7000 to 8000 husks per day:—

	£	s.
One crusher mill	32	0
Six breaking-down mills	185	0
One Willy machine	39	10
Superior hydraulic press, with double pumps and fittings	230	0
Shafting, belting, pulleys, &c.	70	0
Twelve combs, assorted	5	0
Eight horse-power high-pressure engine, with large boiler	270	0
Packing for shipment	27	0

The foregoing machines, when all working properly, and with nuts of good quality, should produce from 32 to 35 cwts. of fibre, and 7 to 8 cwts. of brush fibre per day of ten hours.

One thousand husks of average size and good quality prepared by this machinery should produce $4\frac{1}{2}$ to $5\frac{1}{2}$ cwts. of fibre, and about 1 cwt. of brush fibre.

It is assumed that "soaking tanks" of wood or brickwork in cement can be made on the spot, and used in place of iron tanks, and therefore these are omitted in this estimate.

The cost of a single "breaking-down mill" will be found from the price given in above estimate for six machines.

COIR (EXCLUDING CORDAGE) SHIPMENTS FROM INDIA.

	Cwts.		Cwts.
1877	176,684	1883	173,209
1878	41,016	1884	176,930
1879	189,782	1885	239,379
1880	132,572	1886	207,224
1881	129,913	1887	220,969
1882	230,299	1888	186,405

Considering the wide-spread range of this palm, it is strange that the import of coconut oil has made such little progress compared with its great rival, the African oil palm. One reason

may possibly be that the fruit is more generally used for food, and for the refreshing drink in the nuts when young. The coconut palm is cultivated in great abundance on the Malabar and Coromandel coasts, Ceylon, the Laccadives, and everywhere in the Straits Settlements, and the Islands of the Eastern Archipelago. In the Madras Presidency there are no less than 218,000 acres under coconuts.

EXPORTS from INDIA.

Articles.	1885.	1886.	1887.	1888.
Coconuts No.	253,582	255,525	253,630	263,000
Copra cwt.	64,323	21,755	9,337	21,027
Coir "	15,581	8,995	12,347	7,912
Coir manufactures ..	221,554	198,229	208,622	178,493
Cordage and Rope ..	32,140	28,755	28,256	20,137

In the West Indies, Central America, and Brazil, the coconut is extensively grown; there are groves of it for about 280 miles along the coast of Brazil. From Para alone $7\frac{1}{2}$ million coconuts, worth £130,000, are annually shipped to the United States and elsewhere.

The annual produce of the plantations on the Island of Itamarca on that coast is about 400,000 nuts, which would yield more than 2100 cwt. of coir. This island is but three leagues in length, and as the coast alone is planted with these palms, and they are thus productive, what might not all the coconut groves yield, which extend along the coast from the river San Francisco to the bar of Maranguape, a distance of 94 leagues, all cultivated with coconut trees?

The most valuable product of commerce in Malabar is that from the coconut tree.

Many years ago Dr. Royle estimated the average produce of coconuts from the whole of Malabar at from 300 to 400 millions annually, valued at £50,000, and copperah, or the dried kernels, was exported for as much more. Thirty years ago there were in Travancore more than $5\frac{1}{2}$ million coconut trees, and since that period the cultivation has largely increased, as the demand for the oil and the coir has advanced. From Cochin more than 3000 tons of oil are exported. During the last fifteen years the natives of Cochin have been bestowing a vast amount of attention on coconut cultivation, and some idea of the rate at which this is carried on may be realised from the fact that paddy (rice) land is converted into coconut plantations, and large portions of the backwater are reclaimed, and at once planted with coconut trees.

Besides those grown locally, there is a large annual import of coconuts into Bengal.

Six or seven millions are imported annually into India from the Straits Settlements, two millions from Ceylon, and from six to ten millions from the Maldives.

Ceylon.—The great importance of this palm in Ceylon may be

estimated from the fact that the value of the coconut plantations in the island are estimated at £15,000,000. In 1865 there were 332,890 acres under coconuts, chiefly situated in the north-western, northern, and southern provinces.

Mr. Ferguson, in his work on Ceylon, states that there are now probably thirty millions of coconut palms cultivated in Ceylon, covering about 550,090 acres, nearly all owned by natives. The annual yield of nuts may be taken at 1100 millions. There are nearly 3000 native oil crushers driven by bullocks, besides several establishments where steam is used for the oil presses. The value of the exports of this palm in 1886 he gives as follows:—

	£
Oil	400,000
Coir	60,000
Arrack	20,000
Copra	100,000
Poonac	10,000
Nuts	10,000
Miscellaneous Products	5,000
	£605,000

while the value of the products locally consumed he estimates at $1\frac{1}{2}$ million pounds sterling.

Assuming 550,000 acres, at an average of 60 trees to one acre (there are sometimes more, sometimes less), and 35 nuts a year for each tree (a good plantation will sometimes give 80, and in exceptional cases more; others, of course, will usually give less), this gives 33 million trees and 1,155 million nuts. Of the ordinary nuts about 100 would be required to make $2\frac{1}{2}$ gallons of oil. At $12\frac{1}{2}$ gallons to the cwt., this comes to 2,310,000 cwts., at say 26s. the cwt. Poonac is of value as manure; each nut will give $\frac{1}{3}$ lb., worth 6s. 6d. the cwt.

The nature of the different exports for 1886 were:—

	Cwts.
Oil	234,308
Copra	127,899
Poonac	42,484
Coir rope	7,816
Coir yarn	74,146
Coir fibre	17,219

The value of the products of this palm exported from Ceylon in 1884 was in round numbers about £800,000, and of other palms £85,000. The average annual export of oil in the three years ending 1884 was nearly 4,000,000 gallons, and of coir 99,600 cwts.

The price of coconut oil in the English market has fluctuated a good deal. In 1878 it fetched about 43s. 6d. and in 1886 it was only worth 27s. 6d. a cwt.

So far back as 1857, the value of the products of the coconut shipped from Ceylon, exclusive of those used in the island, was £274,462, thus made up:—

	Quantity.	Value.
		£.
Coconuts	420,857 No.	3,717
Coir rope	18,881 cwts.	13,984
Coir yarn	31,652 „	21,364
Copra or dried pulp	20,381 „	12,143
Oil	1,767,431 galls.	223,254

Cochin China.—There are nearly 60,000 acres planted with coconuts, which yield about 9000 nuts per acre, and 1000 nuts give there 15 or 16 gallons of oil.

In the French colonies of Pondicherry, Karikal, Mahe, and Yamaon there are about 12,000,000 nuts produced and 1,000,000 gallons of oil.

In Netherlands India there are 32 varieties of the coconut palm described in Filet's 'Plants' of that region.

In 1884 copra to the value of £300,000 was imported into Holland, chiefly from Java and the other islands under the Dutch rule, and re-exported.

The coconut palm flourishes everywhere in the islands of the Eastern Archipelago, inland as well as on the sea-shore, which is somewhat strange, for in many places there is a theory that sea air is a necessity for it, whereas in the Philippine Islands groves of countless thousands of them exist far inland, bearing heavily and looking extremely healthy. In North-Eastern Borneo the only groves known, one at Malapi and one at Segaliud, bear nuts larger than the average. The demand for coconuts and copra is very large, and with cheap labour North Borneo is able to produce nuts at a lower rate than almost any other country. The great point in its favour is that, owing to the suitability of the soil and climate, trees bear fruit much earlier than in most other countries.

A considerable number of trees in a grove should be beginning to bear at from four to five years of age. The uses of the coconut palm are manifold; the nut is almost a necessity all over India and Malaya for curry-making. The dried kernel, known as copra, is in steady demand in England and elsewhere for oil-making and other purposes. Tapped trees yield coconut beer or "tuba," as it is called in the Philippines, and some sugar. The refuse of the kernel after the oil has been extracted (known as poonac in Ceylon) is used for manure and as food for cattle and pigs; the fibrous husks yield coir for yarn rope, and mat-making.

This palm requires considerable care and cost to bring it to the state of bearing fruit. The ripe good-sized nuts from an old tree are in India kept in a well of water for three months, until they germinate; they are then put into the ground in beds of fifty or a hundred and watered every day. In three months more they begin to grow up, and after three years or more they may be transplanted in regular spaces of 15 to 20 feet, watered regularly every other day, and manured occasionally. In about 12 or 15

years they come to bearing, but the yield is in proportion to the care taken to water and manure. At this stage the value of the tree is from £2 to £3.

The natives have this palm generally about their dwellings. The annual value of the produce from the trees in the Archipelago is estimated at £2,500,000, and by greater care and attention it might be double. There were in 1874 in Amboyna 507,349 trees; in Banca, 122,898; in Minahassa, 605,300; in Gorontalo, 261,950.

In Java and Madura there are more than 20,000,000 trees. There are large plantations of coconuts in the Seychelles, and a good many in the Mauritius; 40,000 or 50,000 nuts are shipped yearly from the latter island, and 100 to 400 cwts. of coir cordage.

Coconuts are grown in small quantities throughout the Straits Settlements, but it is only here and there that plantations of any magnitude are met with.

There is, perhaps, no tropical colony that has so many advantages for coir-making as the island of Penang. At present all the use the palm is put to, with the exception of making a rope for a well bucket, or for some other trifling domestic purpose, is for fuel. In the oil factories the husk is used as firing in boiling the kernel into oil, as well as in boiling rice and curry in the kitchens. About a couple of million nuts are also shipped from the Straits Settlements with the husk on.

Coconuts growing in mangrove soil on the side of creeks, and more or less saturated with salt, have their milk brackish, and the sap from which it is secreted must be saline also. These trees do not suffer from the attacks of the rhinoceros beetle. Trees planted in such a situation are found to bear much sooner than those planted on a sandy soil. It is true that the milk of the nuts produced by such trees is slightly brackish, but the kernel is as thick as that of coconuts grown on sandy soil, and produces as much oil. The chief requisite with regard to a plantation in such a situation is attention to the drainage. Drains should be cut longitudinally between each row of trees and cross ones at greater intervals. These drains must be kept clear, so as to allow the salt water to flow in and out freely. The tide is found to deposit amongst the trees a very fertilizing matter. If the drains are not attended to and the water stagnates, the trees get dwarfed and become thin towards the top, thereby preventing them from having a large crown.

In New Caledonia this palm is abundant on the north-east coast of the island, but is rare on the opposite coast, and while it flourishes on the northern aspect, it declines towards the south. It may be added, however, that nowhere does it vegetate so well as on the islands approaching the Line. It bears from 60 to 80 fruit. This palm is widely spread over the Pacific Islands, and a considerable trade is carried on in coconut oil.

In the French Oceanic Islands there are about 900,000 acres covered with coconut palms, which produce about 1,500,000 nuts and nearly 2,000,000 kilos. of copra.

In the Marquesas Islands this palm extends from the sea coast

to the mountains, and there are about 400,000 trees. The Samoa Islands ship 3000 tons of copra, principally through a Hamburg commercial company.

From the Friendly Islands a few hundred tons of copra are shipped. The manufacture is carried on there in the rudest manner. The nut is scraped and placed, mixed with a little sea water, in hollow logs to putrefy. The oil disengages itself, and is collected at the bottom of the trough.

Fiji.—The coconut, one of the most beautiful of the palms, is certainly the most generally valuable. It is grown altogether within the Tropics, but its favourite localities are on the low-lying coast lands of the West India Islands, tropical Africa, India, the Malayan Archipelago, Straits Settlements, and the islands of the South Pacific.

The South Sea Islands have been celebrated for many years for the vigorous growth of their coconut palms. These palms were not cultivated except in the most crude and primitive manner, yet, withal, the produce has been truly marvellous.

However, within the last ten years considerable attention has been called to this product, and a number of large plantations made. Since Fiji was created a British dependency considerable sums have been invested in planting and cultivating coconuts. The cultivation on many such plantations is thorough and systematic, and the appearance of those coming into bearing is such as to gratify the planter and promise very handsome returns.

The smaller islands of Fiji, and the coasts of the larger islands, are peculiarly well suited to the cultivation of the coconut, as here you have the sea breeze blowing all the year round over your land and trees. Sandy beach flats, almost level with the sea, are the favourite haunts of the coconut, and there its greatest vigour is attained.

The more elevated lands when near the sea are also eminently suited to it, especially if the geological formation be coral or well-disintegrated volcanic rock. Some persons have asserted that the tree will not thrive nor bear fruit at any great elevation above sea-level. This may be true on very large islands or continents, but the opposite has been proved in Fiji, where in the far interior of Viti Levu coconut trees bear well. It therefore may be considered as certain that in the parts of Fiji suitable, and where soil, &c., is favourable, the coconut palm will flourish well inland and up to, at least, an elevation of 500 feet.

The area planted with coconuts in the Fiji Islands exceeds 10,000 acres. The declared value of the copra exported in 1878 was £123,000, since then it has declined. The coconuts exported in 1887 were to the value of £2220. About fifty coconut palms are planted to the acre, and, in full bearing, yield an annual crop of about 100 nuts each tree. The acre will thus produce, say, a ton of copra, worth on the plantation £12 10s., besides fibre, hundreds of tons of which are exported to Sydney, and used in various manufactures.

Probably no crop or product is to be found where so large a

return is obtainable at so small a risk as that of coconuts. In Fiji, where the coconut thrives so luxuriantly, it is without doubt destined to be, with sugar, coffee, and tea, a great source of wealth.

Amongst other products of the coconut palm that of fibre is probably the second in value, the kernel of the nut standing first.

This husk is removed by the clever use of a steel-pointed stick stuck in the ground, it is then placed in large tanks filled with water; steam is applied, and the husks are allowed to soak for twelve to twenty-four hours.

They are then passed between very powerful fluted metal rollers, which flatten them out to some extent and softens the woody matter they contain.

From this the husks are passed to the "devil," which is a machine having a large cylinder or drum filled with sharp steel teeth. The cylinder is driven by steam power at a very high speed, and, the teeth operating on the husk, reduces it to coir fibre.

There are different kinds of "devils" or coir machines. Some in use in Fiji have been made in Sydney, and do their work fairly. These machines, however, turn out only one quality of coir. On the other hand, there are a number of very superior English-made coir machines, which turn out coir of various qualities, and in very marketable condition.

The chief market hitherto for the coir fibre made in Fiji has been Australia and New Zealand; but, as the production increases, a further market will have to be found amongst the greater centres of population.

The husks from 7000 coconuts produce about one ton of fibre, which is of the value on the estate in Fiji of from £5 to £15 per ton, according to quality. Brush fibre or bristles is worth from £15 to £30 per ton, and yarn from £20 to £30 per ton in Fiji.

The cost of labour to produce one ton of fibre, exclusive of cost and wear of machinery, may be put down at from £5 to £10.

The exports of copra from Fiji in 1887 were to the value of £59,241, and of fibre £1032. In 1885, 5235 tons of copra were shipped.

From the Tuamotus Archipelago a few thousand tons of copra are shipped, but this is nothing to what may be expected. The single island of Anaa, it is stated, has more than 7,000,000 coconut palms. Assuming half of these are too old or too young to fruit, there remain 3,500,000, and, supposing 1,500,000 of these required to nourish the 1500 inhabitants and their live stock, there would remain 2,000,000 to furnish the raw materials of commerce. As a very ordinary tree would furnish 25 nuts yearly, this would give 50,000,000, and, as 100 nuts yield 50 lbs. of copra, we have a total of 25,000,000 lbs. available for export. It might yield 12,000 tons with proper management.

For preparing copra it is well to collect only ripe nuts, and not to break the nut until a month or six weeks after it has been gathered; the copra then dries more quickly, is richer in oil, and does not turn mouldy.

Jamaica.—Ten or twelve years ago no less than 20,000 coconut

palms were planted on the long sandy spit known as the Palisadoes, running from Kingston to Port Royal. It is a generally accepted opinion that this tree flourishes luxuriantly in all maritime tropical regions, on the arid sandy sea-shore as well as in the richest valleys. There can, however, be no doubt that the tree grows with far greater luxuriance under favourable conditions of abundant moisture and rich soil, and it is in consideration of this that the annual yield of each tree is estimated at the low rate of 2s. The land on the Palisadoes is composed chiefly of sand, with an admixture throughout its greater extent of a rich vegetable mould. Severe droughts of from six to nine months' duration are frequently experienced, and, although the tree may flourish in proximity to the sea, a greater rainfall on this sandy soil would double the return. The extremely arid condition of the Palisadoes and the neighbourhood of Kingston, probably the driest spot in the West Indies, has been brought about by the wholesale destruction of the primeval forest over hills and plains to the extent, including the continuation of the plain to the west, of from four to five hundred square miles. Along the line of the shore the palm luxuriates throughout this district, but, on receding to the distance of half a mile, it ceases to present a flourishing aspect, until we reach the hills or the plain beyond the arid region where it again acquires the necessary condition—moisture. It would be a matter of some importance for statistical as well as utilitarian purposes to ascertain what number of coconut trees there are in the island. In the East Indies these palms are carefully enumerated, and in some parts a yearly tax is levied on each, and even mortgages are commonly secured to the extent of 2s. a tree. The 6,000,000 nuts, worth about £20,000, exported annually from Jamaica, give a very imperfect idea of the value of the tree to the colony. In each of several parishes, for instance, St. Thomas, Portland, and St. Mary, there must be over 100,000 fruiting trees, and the number is being constantly increased. Wherever the tree abounds, the nuts form an important article of food among the peasantry, either in their natural state or manufactured into oil. By the peasantry, however, the husk is not turned to any account, and is only manufactured to a very trifling extent in prisons, whilst if, at a moderate computation, we estimate the number of bearing trees at 1,000,000, each yielding on an average 60 nuts, the husks, if utilised, would give at least £50,000. Fifty million nuts made into oil would yield 1,000,000 gallons, which, at 4s. per gallon, would be worth £200,000. Factories established where the trees abound would, in addition to expressing the oil, utilise the valuable coir, which would in itself be a source of considerable profit. Coconuts abound around nearly the whole sea-board of the island; and within thirty miles of Kingston they are obtainable in large quantities, at 100 per cent. less than they are bought for in town. It is a pity that the highly valuable products of this palm are not turned to better account, and it would be a great boon to the colony if private enterprise would initiate a system of manufacturing oil for island consumption and coir for exportation,

as the nuts could be obtained in quantities to meet any demand, and brought to town in the coasting droghers. How many hundreds of acres are now covered with this stately palm, and how many thousands of the nuts annually fall to the ground, almost useless to the proprietor!

It is a low and safe estimate to take the value of the produce of an acre of coconuts in bearing at from £8 to £10. On the sea-shore these trees begin to bear in six or seven years. A great part of the waste shore of this island is very suitable for the growth of the coconut; and the demand for this most useful of all fruits, even where no machinery has been erected for the preparation of its products, is unlimited. The disease which destroyed the coconut palm in some West Indian islands is unknown in Jamaica. Of late years coconut trees have been planted, especially on the north side of the island, more extensively than ever before.

Mr. D. Morris thus reports on coconut production in Jamaica:—“Owing to the facilities afforded by the markets of the United States and Great Britain there is a great and increasing demand for coconuts all the year round. They seldom sell locally for less than 50s. or 60s. per thousand, while in times of scarcity the produce has readily obtained 70s. per thousand. At, say, 60s. per thousand, trees bearing at an average 50 nuts per tree would represent an annual value at the rate of 3s. per tree. The general impression in Jamaica is, that a coconut tree is worth ‘a dollar a year.’ In some cases this may be somewhat above the mark, whereas in favourable districts, such as Morant Bay and others, bearing trees may yield on an average as high as 100 nuts and be worth 6s. or even 8s. per tree. A coconut plantation in Jamaica, well-established and in full bearing (say at the end of six years, with 60 trees to the acre, and yielding an average of 40 nuts per tree) may be safely assumed to be worth at the rate of from £8 to £12 per acre; much, however, depends on the locality and the care taken to harvest the produce. The cost of establishing a coconut plantation till it comes into bearing cannot be more than £8 per acre. It appears to take about six to eight months to raise plants from seed nuts. If kept quite moist and buried in shaded nurseries, they will sometimes only take five months before they are ready to be planted out. From the time the spathe bursts till the nuts are mature and full, a period of generally from nine to ten months elapses. Placing the value of the nuts at 40s. per thousand, and 5500 nuts to the ton of copra, this would give £11 as its first cost per ton. To this must be added cost of preparation and shipping expenses, which would be not less than £5, hence, with coconuts at 40s. per thousand, the cost of placing a ton of copra in the London market would be about £16. At the present high price of coconuts it is certainly more remunerative to sell them as they are; but should the price of coconuts fall below 40s. per thousand, it would be better to make copra, and ship the produce in that state. In the Pacific Islands and other places remote from good markets for fresh nuts, the manufacture of copra

has become a large and important industry. The extension of coconut plantations in Jamaica may, therefore, be undertaken with every confidence that they will prove of a thoroughly remunerative character, and this, it must be noted, without any reference to the husk, which, with suitable machinery, might in itself form the basis of an important industry."

The cost of establishing a coconut plantation in Jamaica, including all expenses until it comes into bearing, does not amount to more than £8 per acre, and when well established and in full bearing (say at the end of eight years, with sixty trees to the acre) it may safely be assumed to be worth at the rate of £10 per acre.

In *Trinidad* great attention has of late years been given to coconut production. In 1863 and 1864 only 250,000 were shipped annually, but in 1884 and 1885 the number had risen to 10,000,000 and 11,000,000. The civilized world of the temperate zone can absorb all the oil and fibre the tropics are likely to send for generations to come, however great the supply. The trees are always in bearing, but in some quarters, at least, the Trinidad planters confine themselves to three great regular pluckings at four months apart—namely, in April, August, and December. The cultivation is extending on the shores of the colony.

The coconut palm grows luxuriantly all along the sandy shores of the southern and eastern coasts of this island. Although the simplest, it is far from the least profitable of the agricultural industries of the colony. The fact that the number of coconuts exported from Trinidad has risen from 4,500,000 in 1876 to 11,300,000 in 1884, clearly proves that this industry is a paying and progressive one, and it is also one suitable for small capitalists who can afford to wait for a return.

Beyond the purchase money of the land and the expense of putting in the plants, but little expenditure is necessary, and when fully established—say at the end of eight years—it will give regularly a net income of from 3s. 4d. to 4s. 2d. per tree.

The expense of maintaining a coconut plantation, when once established, is practically nothing. In Trinidad the coconut palm has been known to flower when only three years old, and generally bears at between five and six years; it does not, however, bear fully until eight years old. There are now three coconut oil factories in the island. The quantity of oil manufactured annually has hitherto been only about 45,000 gallons.

This, though a very profitable industry, takes a good many years before any returns are apparent. The planter must not expect that all lands are suitable for coconut cultivation, nor that it will thrive too far inland, as the coconut palm prefers the proximity of the seashore. This tree will not bear much before it is eight years old, but experiments are being tried in Trinidad to make it a shade-tree to the cacao tree, growing beneath it instead of employing the quiet-growing *Bois immortelle*.

The idea is, of course, to derive in course of time a crop of coconuts as well as the cacao from the same land. A coconut

plantation costs very little indeed to keep up when once formed, but, of course, it involves a lock-up of capital for a good many years.

Seventy coconut palms to the acre would be the right quantity planted about 25 feet apart; seventy such trees in full bearing will yield 5000 nuts per annum, and would net from £3 to £4 per thousand in Trinidad as an average price. London alone imports about 12,000,000 per annum, and New York immense quantities, large numbers are also consumed locally for making coconut oil.

The coconut can be grown in unlimited quantities on the eastern coast of the island, where two factories have been established for some time for the preparation of oil and fibre. The difficulties of procuring labour in that remote part of the island, and of shipping the produce on an exposed coast, have hitherto retarded the commercial success of these establishments; but, if these difficulties can be overcome, a large extension may be given to this branch of colonial industry.

There is a considerable demand for coconuts in the United States, but then the American captains require them to be delivered husked, and they must be large and spherical. As the fibre could be so readily utilized in the States, it is rather singular the traders do not offer to buy the nuts, as picked, at the low rates current in these islands, and husk and sort them after arrival in America, selling the large handsome nuts to the first-class fruiterers, confectioners, and grocers; the smaller nuts to the street-seller, and the husk to the mat, mattress, and brushmaker, the rancid nuts, if any, going to the soap-boiler. In Trinidad there is grown a goodly proportion of lusty, handsome nuts, as there are first-class soils for the tree, an equatorial climate and prolific bearers. Planting is always extending, at Mayaro, Icacos, Irois, Carenage, and other places, leaving many virgin beaches, along which, sooner or later, they will be dotted.

A couple of men in the vicinity of Key West, Florida, have started a grove of 4000 coconut trees on a small island, and the young plants are said to be thrifty and vigorous. They had no trouble in germinating the nuts, but their chief trouble was the annoyance of rats, which eat down the shoots, and to some extent check their growth. At six or seven years of age the trees begin to bear. The coconut shows fruit at all stages of development, from the flower to the ripened fruit. Besides being highly ornamental in appearance, the fruit is an article of considerable commercial importance, as the demand from the factories that prepare it in a desiccated form, and also its large employment in confectionery, are constantly on the increase. The estimated value of the yield is from \$7 to \$10 for each tree, and the cultivation is not as careful or expensive as that required for the orange. Many others are contemplating engaging in this industry in that State, around the coral reefs in the southern part. The coconut palm attains great age and is a certain producer; therefore the result cannot fail to be highly profitable to those who engage in the business. In a few years the Keys will, no doubt,

present a beautiful appearance, fringed by a border of this most graceful variety of the palm family.

Coconuts are imported in large quantities into New York, and the confectioners in that city use up about 500,000 of them per month. One house (Croft, Wilbur & Co.) has a contract for 100,000 per month. They come from Jamaica, Cuba, and the Spanish Main, and sell from \$37.50 to \$50 per thousand.

THE AFRICAN OIL PALM (*Elaeis guineensis*, Lin.) is, after the coconut palm, one of the most important in a commercial point of view, since it furnishes to British commerce about 50,000 tons of oil annually, of the value of one million sterling, besides the quantity locally consumed as food in Africa, and sent to other countries. It is distinguished by its decumbent trunk, and bears clusters of one-seeded fruits (drupes), with oily husks of a bright vermilion or a more or less yellow colour. The range of this palm is not as yet well defined, but appears to extend from the coast of Guinea to the south of Fernando Po, and grows as far up in the interior as Zheru, a distance of 400 miles from the sea, or the mouth of the Min, one of the embouchures of the Niger.

The oil palm does not grow near the coast, and the produce is brought down on the heads of carriers to the Gold Coast from an area extending 40 miles inland, and by canoe down the Volta river from a greater distance.

This African palm was introduced into Java twenty or thirty years ago by Dr. W. H. de Vriese, and in 1871 Mr. Denison planted 5000 trees at Koripan in Buitenzorg. In 1876 700 trees were introduced into our colony of Labuan by Sir J. Hooker. The tree yields about 20 lbs. of nuts in a season, of which there are two. They bear in 7 to 12 years, and continue bearing 35 to 40 years. It takes 30 to 35 lbs. of palm fruit to make a gallon of oil. In trade the oil is distinguished into hard and soft, according as it contains stearine.

Captain Burton, in his 'Lake Regions of Central Africa,' states that this palm is known by the Arabs to grow in the islands of Zanzibar and Pemba, and more rarely in the mountains of Usagona. It springs up apparently uncultivated in large dark groves on the shores of the Tanganyika, where it hugs the margin, rarely growing at any distance inland. This fine palm is also tapped, as the date palm is in Western India, for toddy, and the cheapness of this timbo—the *sura* of Western Africa—accounts for the prevalence of intoxication, and the consequent demoralization of the Lake tribes.

The principal ports in the Bight of Benin from which palm oil is exported are Badagry, Porto Novo, Whydah, Aliquah, Lagos, and Palmas.

Palm oil is exported from the following rivers:—Brass, New Calabar, Bonny, Old Calabar, Bemba, Cameroons, and also from Fernando Po. Independent of these, in the rivers Malunba, Boreah, and Kampo, palm oil is brought by coasting vessels. Bonny supplies the largest amount of palm oil that is brought from any river in West Africa.

The process of extracting the oil is simple. The clusters or branches of fruit, which contain perhaps as many as 4000, are gathered by the men, and thrown indiscriminately into a trench or pit, and so left until they become somewhat decayed. The fruit is afterwards pounded in a mortar to loosen the husky fibre covering the nut. This done, they are placed in large clay vats filled with water, and two or three women tread out the semi-liquid oil, which comes to the surface as disengaged from the fibre, when it is collected and boiled to get rid of the water. The inner surface of these clay vats having at first absorbed a small quantity of oil, is not afterwards affected by the water or oil. The oil is collected in pots, containing from three to twenty gallons.

M. Boussingault has shown, from information collected,* that the average production of oil from palms is at the rate of 900 kilos. per hectare, that is to say, superior by a third to the production of oil from the olive in the south of Europe.

This vegetable fat is stated by A. C. Oudemans, jun., to have the following remarkable composition: stearin, palmitin, myristin, laurein, elain, caprin, caproin, and caprylin. It is used with the other solid fats for making soap and candles, and for railway grease. The price of the oil has fallen very much of late from 35s. a cwt. to 21s. a cwt. The enormous progress that has been made in the commerce in this article is shown by comparing the imports of 1840 with those of the last six years, which have averaged 48,000 tons, and this is only the British imports.

				Cwts.					Cwts.
1840	..	..	..	315,504	|	1870	..	..	868,270
1850	..	..	..	447,797	|	1880	..	..	1,032,823
1860	..	..	..	804,326	|	1888	..	..	955,369

Marseilles also receives over 1500 tons direct, and the United States some quantity.

The oil rivers of Biafra and Benin extend over 800 miles of coast, and include the island of Fernando Po. The chief exports consist of palm oil and palm kernels.

The Fernando Po oil crop never exceeds 400 tons a year, and yet, from the number of oil palms there, at least 4000 tons might be obtained, but the 25,000 aborigines do not care to produce more. More oil palms might be grown, for there is abundance of room for them in the oil district, though it is but a mere fringe of the African continent. But the natives never think of planting oil palms. The river chiefs, now oil brokers, were slave brokers formerly.

Our imports of palm oil now reach nearly 50,000 tons, of which more than half is re-exported. The greater part of our imports come from the British settlements on the west coast of Africa.

The following table gives the quantity of palm oil imported into the United Kingdom for a series of years:—

* 'Economie Rurale,' t. i. p. 350.

	Cwts.		Cwts.
1840	315,504	1864	666,582
1841	402,126	1865	798,724
1842	424,242	1866	799,210
1843	418,429	1867	812,080
1844	414,648	1868	960,059
1845	505,704	1869	814,520
1846	366,853	1870	868,270
1847	476,301	1871	1,047,882
1848	510,218	1872	1,006,497
1849	493,331	1873	1,017,947
1850	447,797	1874	1,067,767
1851	608,550	1875	904,562
1852	523,813	1876	879,824
1853	636,628	1877	897,264
1854	752,618	1878	670,797
1855	810,394	1879	881,329
1856	786,701	1880	1,032,823
1857	854,791	1881	826,891
1858	778,230	1882	813,870
1859	685,794	1883	749,422
1860	804,326	1884	841,012
1861	740,332	1885	905,439
1862	865,890	1886	1,004,419
1863	790,224	1887	966,536

Palm-kernel Oil.—The kernels, with the exception of an insignificant quantity used for the manufacture of oil for domestic purposes in Africa, were formerly thrown away. Attention was first drawn to their utilization in Liberia. Within the last fifteen years they have been more generally collected and employed. The shell being broken, the kernels are shipped to be pressed for oil, &c. A vast extension of the African trade has arisen out of this new article of export.

The following shows the sources of our imports of palm kernels in the year 1886:—

	Cwts.
Lagos and Gold Coast	412,280
Other West African Settlements	5,442
French Possessions	8,261
Fernando Po (Spanish)	1,493
Portuguese Possessions	72
West Africa not designated	498,761
Foreign countries	78,085
Other British Possessions	35
Total	<u>1,004,419</u>

It has been estimated by competent authorities that from the 50,000 tons of palm oil shipped there must be 10,000,000 bushels of kernels, equal to 223,000 tons in weight. The average yield from these kernels being about 30 per cent., if all were utilized this would furnish 76,000 tons more of oil, worth at the current price about £1,520,000. If we add to this the value of the oilcake, 112,000 tons at £6 per ton, we should have a very large increase to the value of the oil-palm trade with Western Africa.

Palm-nut oil is obtained on the coast from the seed or kernel, by roasting, beating, and boiling. In Liberia, on a small scale, a

bushel of kernels was found to yield two gallons of oil, but with good presses a very much larger yield than this is obtained.

The kernel, which is nearly white, is covered by a thin brownish layer of woody fibre, and in consequence of this the palm-nut meal has a light-brown or dirt-coloured appearance. The size of the kernels varies from that of a hazel nut to that of a small pigeon's egg. They are very hard, nearly inodorous, rather insipid to the taste, and extremely rich in fatty matter, possessing the consistency of butter, with the useful property of not readily turning rancid. The extraction of the oil necessitates the reduction of the kernels into a tolerably fine powder, and the application of powerful crushing machinery and gentle heat. Notwithstanding these means, the cake or meal left in presses contains usually a larger proportion of fat than is found in most other kinds of oilcake. It surpasses all other articles of cattle food in its theoretical value as a fat producer, as the following analysis by Dr. Voelcker will show. In the best linseed cake the percentage of oil rarely amounts to 12 per cent., indeed 10 per cent. may be taken as a fair average:—

Moisture	7.49
Fatty matters	26.57
Albuminous compounds* (flesh-forming matters) ..	15.75
Starch, mucilage, sugar, and digestible fibre ..	37.89
Woody fibre (cellulose)	8.40
Mineral matters (ash)	3.90
Total	100.00

* Containing nitrogen, 2.52.

In 1863 the palm-kernel trade, then newly introduced, furnished 2665 tons of kernels from Lagos. The progress that has been made since is shown by the following figures:—

	Tons.		Tons.
1865	2,631	1876	30,305
1866	7,216	1877	30,875
1867	13,619	1878	27,873
1868	15,498½	1879	27,839
1869	20,394	1880	29,632
1870	15,894	1881	20,801
1871	19,375	1882	28,592
1872	16,870	1883	25,821
1873	16,410	1884	29,773
1874	25,192	1885	30,805
1875	26,454		

From the other ports the quantities received have been:—

Year.	Gold Coast.	Gambia.	Sierra Leone.
	Tons.	Tons.	Bushels.
1879	6,218	41	513,258
1880	11,447	228	366,318
1881	6,288	109	388,915
			Cwts.
1882	8,155	358	180,800
1883	7,429	142	193,075
1884	38,702*	119	194,131
1885	35,796*	223	202,643

* These include the Lagos exports.

The value of the palm kernels now shipped from the single port of Lagos averages nearly £300,000 per annum, or more than that of the palm oil, which in 1885 was but £218,410.

At Rotterdam there was received in tons:—

Year.	Palm Nuts.	Palm Oil.
1884	4,947	2,580
1885	4,249	3,036
1886	3,095	1,868

There was shipped from the Congo State, in 1886–87, 3568 tons of palm nut kernels, and 1,328,290 kilos. of palm oil.

THE GOMUTI PALM (*Arenga saccharifera*, Lab. ; *Saguerus Rumphii*, Roxb. ; *Borassus Gomutus*, Lour. ; *Gomutus saccharifera*, Spr.) is one of the most useful palms, and occurs in a wild state throughout the islands of the Indian Archipelago, but is more common in the interior, principally in the hilly districts, than on the sea-coast, and is also very generally cultivated by the various people who inhabit that region. It is indigenous to Sonda and the Philippines, and is cultivated generally in tropical Asia. This palm attains a height of thirty or forty feet, and besides its saccharine sap furnishes a highly valuable black fibrous substance, Ejoo fibre, superior in quality, cheapness, and durability to that obtained from the husk of the coconut, and renowned for its power of resisting wet. It is used by the natives of the Indian islands for every purpose of cordage, domestic and naval, and is known as Tsongli. Underneath this material is found a substance of a soft gossamer-like texture, which is imported into China. It is applied as oakum in caulking the seams of ships, and more generally as tinder for kindling fire: it is for the latter purpose that it is chiefly in request among the Chinese.

The principal production of this palm is the toddy (from the Sanscrit *Táde*), which is obtained according to Crawford in the following manner: One of the spadices is on the first appearance of fruit beaten on three successive days with a small stick, with the view of determining the sap to the wounded part. The spadix is then cut a little way from its root (base), and the liquor which pours out is received in pots of earthenware, in bamboos, or other vessels. The Gomuti palm is fit to yield toddy when nine or ten years old, and continues to yield it for two years, at the average rate of three quarts a day.

When newly drawn the liquor is clear, and in taste resembles fresh must. In a very short time it becomes turbid, whitish, and somewhat acid, and quickly runs into the vinous fermentation, acquiring an intoxicating quality. In this state great quantities are consumed; a still larger quantity is applied to the purpose of yielding sugar. With this view the liquor is boiled to a syrup, and thrown out to cool in small vessels, the form of which it takes,

and in this shape it is sold in the markets. This sugar is of a dark colour and greasy consistence, with a peculiar flavour; it is the only sugar used by the native population. The wine of this palm is also used by the Chinese residing in the Indian islands in the preparation of the celebrated Batavian arrack.

In Malacca, the Gomuti, there termed Kabong, is principally cultivated for the juice which it yields for the manufacture of sugar. Like the coconut palm, it comes into bearing after the seventh year. It produces two kinds of "mayams" or spadices, male and female. The female spadix yields fruit, but no juice, and the male *vice versâ*. Some trees will produce five or six female spadices before they yield a single male one, and such trees are considered unprofitable by the toddy collectors; but it is said that in this case they yield sago equal in quality, though not in quantity, to the *Cycas circinalis*, though it is not always put to such a requisition by the natives; others will produce only one or two female spadices, and the rest male, from each of which the quantity of juice extracted is the same as that obtained from the coconut spadices. A single tree will yield in one day sufficient juice for the manufacture of five bundles of jaggery, valued at two cents each. The number of mayams shooting out at any one time may be averaged at two, although three is not an uncommon case. When other occupation or sickness prevents the owner from manufacturing jaggery, the juice is put into a jar, where in a few days it is converted into excellent vinegar, equal in strength to that produced by the vinous fermentation of Europe. Each mayam will yield toddy for at least three months, often for five, and fresh mayams make their appearance before the old ones are exhausted; in this way a tree is kept in a state of productiveness for a number of years, the first mayam opening at the top of the stem, the next lower down, and so on, until at last it yields one at the bottom of the trunk, with which the tree terminates its existence.

Dr. J. E. de Vry states that, although the natives in Java extract it by a very rude and entirely primitive mode, this palm contains a great proportion of cane sugar. He thus describes the process, which differs little from that pursued for obtaining sap and sugar from other palms:—

"As soon as the palm begins to blossom, they cut off the part of the stem that bears the flower; there flows from the cut a sap containing sugar, which they collect in tubes made of bamboo cane, previously exposed to smoke, in order to prevent the fermentation of the juice, which, without this precaution, would take place very quickly under the double influence of the heat of the climate and the presence of a nitrogenous matter.

"The juice thus obtained is immediately poured into shallow iron basins, heated by fire, and is thickened by evaporation, till a drop falling on a cold surface solidifies; this degree of concentration attained, the contents of the kettle are put in forms or great prismatic lozenges. Several thousand pounds of sugar are thus obtained yearly. I have collected some of the sap in a clean glass bottle, and I found that the unaltered juice does not contain any

glucose, but a nitrogenous matter, which, by the heat of the climate, quickly converts a part of the cane sugar into glucose. In order to prove, without employing any artificial means, that the juice exuding from the tree contains pure cane sugar, I collected a sample directly in alcohol; the nitrogenous principle is thus eliminated by coagulation; a mixture of equal parts of juice and alcohol has been, after filtration, evaporated on the sand-bath to the consistence of syrup. I brought this syrup with me on returning from Java, and during the voyage it became solid, presenting very fine and well-defined crystals of cane sugar, immediately recognized as such by all the experts. At the Congress of Giessen I spoke of the preparation of sugar from palms as the only rational mode of obtaining sugar in the future, basing my opinion on the following grounds: Sugar, by itself, being only composed, in a state of purity, of carbon, hydrogen, and oxygen, does not take anything from the soil; but the plants now mainly cultivated for extracting sugar, viz., the *Beta vulgaris* and the *Saccharum officinarum*, require for their development a great amount of substances from the soil in which they grow, whence it follows that their culture exhausts the soil. But this is not the only evil; what is worse is, that the space now occupied by beetroots in Europe, and by sugar-cane between the tropics, might and ought to serve for the culture of wheat or of forage in Europe, and for rice under the tropics; and it is my opinion that, considering the increase of population, the time is not far distant when it will be absolutely necessary to devote to the culture of wheat or rice the lands now employed for beetroot or cane. While the cane and beetroot require a soil fit for cereals, the Arenga palm prospers on soils entirely unfit for their culture, so unfit, indeed, that one might try in vain to grow on them rice or cereals. This palm thrives in the profound valleys of Java, and in some parts of the island extends from the shores of the sea to the interior, where the tree is found in groups, and it is very possible to make rich plantations of that fine tree. There is one drawback, but not a very serious one; the tree must be eleven or twelve years old before it will yield sugar. When, however, it commences, the operation can be repeated during several years, and the preparation of the sugar becomes a continuous industry, and not an interrupted one, as it is now. According to my average, a field of thirty ares ($\frac{3}{4}$ acre) planted with those trees should produce yearly 2400 kilogrammes of sugar in a soil quite unfit for any other kind of culture."

Like the true sago palm, the Gomuti affords a medullary matter from which a farina is prepared. In Java it is the only source of this substance, which in the western and poorer part of the island is used in considerable quantity and offered for sale in all the markets. It is smaller in quantity than the pith of the true sago tree, more difficult to extract, and inferior in quality, having a certain peculiar flavour from which the farina of the true sago is free. Dr. Roxburgh observes, "I cannot avoid recommending to every one who possesses land in India, particularly such as is low

and near the coasts, to extend the cultivation of this useful and elegant palm as much as possible. The wine itself and the sugar it yields, the black fibre for cables and cordages, and the pith for sago, independent of many other uses, are objects of very great importance. From observations made in the Botanic Garden at Calcutta, well-grown thriving trees produce about six leaves annually, and each leaf yields from 8 to 16 ounces of the clean fibre. They are in blossom all the year; one lately cut down yielded about 150 lbs. of good sago meal."

The interior of the small fruit are prepared and extensively used as sweetmeats by the Chinese in Sumatra.

THE WILD DATE PALM OF INDIA.—The following paper, on "The Manufacture of Date Sugar," is by Mr. S. H. Robinson, of Calcutta:—

Phoenix, the genus to which the date palm belongs, comprises nine known species, of which six are indigenous in India, and are distinguished as: 1, *acaulis*; 2, *dactylifera*; 3, *pusilla*; 4, *farinifera*; 5, *sylvestris*; 6, *paludosa*. Of these No. 4 produces sago of an inferior quality, and the leaves of all the species furnish materials for mats or thatch for houses. The sugar-yielding variety, *Phoenix sylvestris*, is known as the wild date of Bengal. *Phoenix dactylifera* is the name given to the true date palm of Arabia and Africa; but as it appears to be undistinguishable from the Bengal variety, except in size and vigour of growth, there seems little doubt that any apparent difference is due only to superior cultivation and variety of climate or soil, and to its being always a cultivated tree in Bengal; the specific name *sylvestris* may have been originally given owing to its inferiority in size to the African or Arabian tree, with which European botanists were more early familiar.

The date palm, when not stunted in its growth by extraction of its juice for sugar, is a very handsome tree, rising in Bengal to from thirty to forty feet in height, with a dense crown of leaves spreading in a hemispherical form from its summit. These leaves are from ten to fifteen feet long, and composed of numerous leaflets or pinnules about eighteen inches long. The trunk is rough, from the adherence of the bases of the falling leaves, which serves to distinguish it at a glance from the smooth-trunked coconut palm, which in its leaves only it resembles. Like all of the *Phoenix* genus, the trees are dioecious, and the fruit hangs in dense bunches from the centre of the crown of the female tree; it flowers about April or May, and the fruit ripens in July or August; the latter is, however, of a very inferior description in Bengal, and is seldom gathered except for seed, from which the young trees are raised. The fruit, indeed, consists more of seed than of pulp, and altogether is only about one-fourth the size of the Arabian kind brought annually to Calcutta for sale, and, when fresh imported, a rich and favourite fruit there. This inferiority of the Bengal fruit may no doubt be attributed to the entire neglect of its improvement there from time immemorial, and, perhaps, in

some measure to the practice of tapping the trees for their sap, so universally followed in the districts around Calcutta, its principal range of growth.

The date tree is met with in almost every part of Bengal Proper, but it flourishes most congenially, and is found plentifully only in the alluvial soils which cover its south-eastern portion, excepting only such tracts as suffer entire submersion annually from the overflow of the rivers, as is common in portions of the Dacca, Mymensing, and Sunderbund districts. The extent of country best suited for its growth, and over which it is found most plentifully as above indicated, may therefore be taken as within an area stretching east and west about 200 miles, and north and south about 100 miles, and comprehending by a rough estimate about 9000 square miles—within an irregular triangular space.

The practice of extracting its juice, however, for the production of sugar extends at present over a much smaller area, probably not more than two-thirds of the above-described space; and if we consider further, how small a portion of these favourite date districts are as yet occupied by date tree cultivation, the room for its future extension, even if confined to these tracts alone, appears a wide one indeed. If we trace an irregular parallelogram, stretching eastward from Kishengunge, in the Nuddea district, to Backergunge, and from Mahdupore, in Furreedpore district, southward to the borders of the Sunderbunds, we shall find a space of about 100 miles long by 80 broad, and comprehending the district of Jessore, with portions of Furreedpore, Nuddea, and Burrisaul, to which the product of date sugar is mainly confined, although the goor—or the first raw produce made by boiling down the juice—is found commonly manufactured for native consumption on the spot, in many localities situated beyond these assumed limits.

Throughout the present date tract, the quantity and quality of the sugar produced vary considerably. The high and dry lands of parts of Kishnaghur and Pubna yield a strong well-crystallized product, though less in quantity than from trees of the Jessore and Sunderbunds soils, in which, with a more rapid growth of the tree and a greater flow of sap, a less rich, though still good and grainy sugar is produced. The cultivation in these districts is accompanied by a great advantage, in the cheap and abundant supply of fuel for boiling the juice and refining the sugar; and there is probably no part of Bengal where the cultivation may be extended with more profit than in the elevated lands of the Sunderbund grants.

The young plants are raised from seed sown during the rains, and are ready for planting out in the following April or May, after the first showers of the season have moistened the ground sufficiently. Before the date sugars became important as a staple for export, and the cultivation extended, the trees were seldom seen planted elsewhere than along the hedge-rows or boundaries of the fields, or on spots where they did not interfere with the growth of cereals or other field crops. Gradually as date produce

became more valuable, systematic plantations appeared, and fields were set with trees ten and fifteen feet apart, but without much regard to order or regularity of distance. After planting, no manuring or further expense was incurred, except, perhaps, in supplying fresh plants in place of those destroyed by cattle.

The spaces between the trees are generally occupied by oil seeds or other dry-weather crops, and thus the cost of a native plantation is reduced, whilst the trees benefit by the ploughing, which loosens the earth, and the ground is kept free from weeds.

At the expiry of the fifth year from the planting of the young tree in the field, it is ready to be tapped for its juice. This is the average time allowed, though it may be varied a year sooner or later by the difference of soil and climate. The first year a young tree is tapped, it is reckoned to yield only half the usual quantity of juice produced by a full-grown tree; in the second year of tapping it is reckoned to yield three-fourths of full average quantity, and it is not till the third year of bearing that it is considered as in full yield.

The process of tapping and extracting the juice commences about the 1st of November. Some days previously the lower leaves of the crown are stripped off all round, and a few extra leaves from the side of the tree intended to be tapped. On the part thus denuded a triangular incision is made with a knife about an inch deep, so as to penetrate through the cortex and divide the sap vessels, each side of the triangle measuring about six inches, with one point downwards, in which is inserted a piece of grooved bamboo, along which the sap trickles, and from thence drops into an earthen pot suspended underneath it by a string. The pots are suspended in the evening, and removed very early the following morning, ere the sun has sufficient power to warm the juice, which would cause it immediately to ferment, and destroy its quality of crystallizing into sugar.

A plantation is always divided by the cultivator into seven equal sections, and one such section is tapped daily. The cutting is made in the afternoon, and the pot suspended as above mentioned. Next morning the pot is found to contain, from a full-grown tree, ten seers of juice, the second morning four seers, and the third morning two seers of juice (the seer is about 2 lbs.); the quantity exuding afterwards is so small, that no pot is suspended for the next four days. On the evening of the seventh day it again comes to the turn of this section of trees to be cut, which is effected by a thin slice being pared from the triangular face, which, by again dividing the sap vessels, causes the juice to flow afresh as at first. Each section is thus cut in succession, and the process is repeated throughout the goor season, which usually terminates about the 15th of February, after which the heat of the weather causes the juice to ferment so rapidly, that it is no longer convertible into sugar, and consequently not worth the labour of extraction and evaporation of its water, as molasses only would be the product. Juice produced during the day-time of the cold season

is of similar quality, and for the same reason is allowed to run to waste.

Daily at sunrise, throughout the goor season, the industrious ryot may be seen climbing his trees and collecting at a convenient spot beneath them the earthen pots containing the juice yielded during the past night. Under a rude shed, covered with the leaves of the date tree itself, and erected under the shade of the plantation, is prepared the boiling apparatus to serve for the goor season. It consists of a hole of about three feet in diameter sunk two feet in the ground, over which are supported by mud arches four thin earthen pans of a semi-globular shape, and eighteen inches in diameter; the hole itself is the furnace, and has two apertures on opposite sides for feeding in the fuel, and for escape of the smoke. The fire is lit as soon as the juice is collected, and poured into the four pans, which are kept constantly supplied with fresh juice as the water evaporates, until the whole produce of the morning is boiled down to the required density. As the contents of each pan become sufficiently boiled, they are ladled out into other earthen pots or jars, of various sizes, from five to twenty seers of contents, according to local custom, and in these the boiled extract cools, crystallizes into a hard compound of granulated sugar and molasses, and is brought to market for sale as goor.

The subsequent processes by which the goor is deprived more or less of its molasses and impurities, and the drier and more merchantable kinds of sugar are prepared for market, will now be briefly described. These processes are always conducted by a distinct class of operators, who purchase the goor from the cultivators, and bring it to various stages of purity and dryness under different denominations.

1st. Khaur is made by filling the goor into coarse sacks or gunny bags, and pressing them between bamboos lashed together, or beneath heavy weights, until 30 or 40 per cent. of the entire weight is forced out in the shape of molasses. The residue is then mixed, packed in clean bags, and is ready for sale.

2nd. Fine khaur or nimphool is made by repeating the above process for making khaur; the only difference being that the khaur is sprinkled and mixed with water before subjecting it to the second packing and pressure. This causes a further portion of the molasses to be washed out and separated from the mass, and the product is lighter coloured and finer than the khaur, and about 50 per cent. only of the original weight of goor remains. A third application of the same process is sometimes resorted to, which carries away another 5 per cent. of the original weight, and leaves a residue still drier and lighter coloured than the ordinary nimphool.

In all nimphool and khaur sugars, however, a certain portion of water or moisture remains, it being never subjected to any sun-drying or other process for evaporating the water, and this renders it liable to deliquesce and sweat through the bags in which it is usually packed. This is specially the case in damp weather, and loss of colour and acidity follow in a few weeks.

3rd. Dullooah, or doloo, is made by filling the goor into round baskets or conical earthen vessels, holding two or three maunds each. The baskets being of an open fabric, and the cones made with a hole at the apex, the molasses drains from the goor into a vessel placed beneath, the process being encouraged by a stratum of three or four inches thick of a wet grass or aquatic weed called "seala" placed on the surface of the goor. The moisture from this attenuates the molasses in the goor, and assists the draining. As soon as the weed is dry it is removed, and the upper stratum of the goor, now deprived of its molasses, is scraped off with a knife to the depth of two or three inches; and a fresh top of seala or wet weed is applied. When dry, a further portion of sugar is cut off as before, and this is repeated until the basket or cone is emptied. The sugar, as scraped off, is exposed in the sun on mats to dry, and is then mixed and packed for sale; and is, when well made, a dry, light, sand-coloured dullooah. Thirty to forty per cent. of produce, varying with the quality of the goor, is made in this way from a given quantity of the latter. The resulting molasses having by the operation of the weed a small portion of the sugar crystal melted with it, is subjected to a boiling to evaporate the water, and an inferior, weak-grained, and dark-coloured goor is the result. This is again subjected to the weed-draining as before, and a further portion of 10 to 15 per cent. weight of the original goor is obtained. Dullooahs, if well dried before being packed, may be kept without deteriorating for several months if the weather be dry; but they always imbibe moisture, and sustain consequent injury from the damp air of the rainy season in Bengal.

4th. Pucka Cheenee, or gurpatta, is the native refined sugar made by subjecting khaur to a process somewhat resembling that of the English refiner. The khaur is melted in water to the consistency of thin syrup, which is then placed over a fire in an earthen pan, and brought to boiling point, the defecation being assisted by potash temper and sprinkling in of cold water. After skimming, it is filtered through a cotton cloth, and the clarified syrup boiled briskly until the water is evaporated to such a degree as to allow the sugar to form a hard crystal as it cools. It is then poured into an earthen cone, and, when cold, the plug is withdrawn and the syrup allowed to drain from it, assisted, as in the dullooah process, by the application of the damp weed or seala. As it becomes whitened by the latter, it is scraped off, sun-dried, and packed for sale. The syrup, as it collects from the cones, is boiled up with fresh goor, and produces, by the same process, an inferior or second quality of gurpatta; the syrups of the latter are once more boiled alone, and produce a still inferior weak and reddish sugar, called by the manufacturers "jerunnee," which is literally "lasts." Gurpatta, if well made, and pure from mixture of other kinds, is of a bright and clean aspect, fine and dry; and, if protected from the weather, will keep without injury throughout the rainy season. The ordinary yield of gurpatta from three maunds (40 seers each) of good goor is reckoned as follows:—

						Mds.	srs.
First or white gurpatta	..	..	..	..	..	0	20
Inferior or mixed ditto	..	..	..	..	..	0	10
Syrup or jerunnee	..	..	..	..	..	0	10
Molasses	..	..	..	..	..	1	28
Loss	..	..	..	..	..	0	12
Total						3	00

5th. Dobarah is a quality superior to gurpatta, being a good white, dry, and well-crystallized sugar. The process is similar to that of the gurpatta; but the material used being dullooah instead of khaur, a purer sugar is obtained, which much resembles the crushed refined sugar of the European refiner.

In the district of Jessore alone, in 1882-83, it is stated that there were 24,122 acres under date cultivation, and that the value of refined and coarse date sugar for that year was calculated at £484,624 in this one district alone.

The following further details are given by Babu Ramshunker, Sen., Deputy Magistrate and Deputy Collector, Jessore:—

In May and June seeds are gathered from under old date trees and sown broadcast in a nursery near enough to the ryot's house. They sprout forth within fifteen to thirty days, and sooner if there is an intervening downpour. The seedlings are then fenced round in order to save the tender leaves from the bite of the goat or cattle. As soon as two leaves appear a weeding begins, which is kept up twice in the year as long as the plants continue in the nursery for two or three years. After this term, when the rains begin to fall copiously, they are transplanted into an open garden, which is prepared by four or five ploughings and manured with sweepings and cowdung. A high and rich ground is always preferred; but soils which are of a mixed nature and easily yield to the plough are better adapted than the low and saline.

The trees are planted in even rows seven or eight cubits apart in order to allow sufficient space for intermediate ventilation and the turning of the plough and ladder within the intervening space. The ground is ploughed, and the soil around the tree is turned up with the spade twice a year, as otherwise the overgrowth of the straw grass (*ulu*) chokes up and kills the tender plants. The side leaves of the plant are cut off every year in winter for the convenience of cultivating the gardens with cold-weather crops, which are generally sown therein as long as the plants are young and their leaves short; but when they have spread out so much as to obstruct heat and light, the cultivation of other crops is put off. The raising of these crops in the date gardens, instead of interfering with the trees, is rather conducive to their growth, as the soil is kept clean thereby and *ulu* grass (*Saccharum cylindricum*) kept back. In gardens where the trees are wide apart, the *aus dhan* is cultivated, and an average crop is always obtained.

Inundations injure the trees when they are young; for if the water rises high, it deposits its loam on the tender head leaves, and thus suffocates the plant to death. The fouler and higher the

water, the greater is the danger to the date tree. Young and robust trees escape storms and cyclones scatheless, but the tall ones are many a time and oft pressed down by the force of the wind, and although not quite uprooted, placed permanently in a slanting position. There is a kind of larva called *maira* or *kora*, which destroys the plant in large numbers by boring out the heads and eating up the top leaves.

When seven or eight years of age, the tree is fit for yielding the sap. Ordinarily the east or west side of the tree, being better exposed to the influence of the sun, is chosen for tapping; but in some cases the north and south sides are also taken up if more convenient for the purpose of ascent and descent. The position and bend of the tree, as well as its accessibility to the climber, determine the side on which the first cutting is to be made. If it stands at an acute angle with the surface of the soil, the side uppermost is subjected to the paring knife. Sometimes a tree in which the first parings were east and west has its subsequent cuttings gradually brought round to north and south, if it has been beaten down by a cyclone. The tapping continues on from year to year until the head of the tree presents a withered and half-dead appearance. In three trees I counted as many as forty-two, forty-three, and forty-four alternate notches, thus showing that they had been continually tapped for those long series of years, and they appeared still capable of being subjected to that process for two or three years more. When on these high and tall trees the head is no longer erect in position, the tapping must cease.

The implements used in cutting the tree are (1) the *gachua dao*, a sharp and broad instrument with which the paring is made; (2) the *kolach* or goatskin cover which the *gachi* or cutter fits to his waist in order to prevent friction of the rope (3), called *dara*, with which he attaches himself to the tree as he climbs up; (4) the *thungi* or narrow wicker basket hanging from his waist like a quiver and intended to hold the *dao* and *nullies*; (5) the *akra* or hook, on which the juice pot is hung when he gets up and down the tree with it.

Besides the cluster of date trees in and around a ryot's tenement, large open gardens occupying broad areas of land are planted with them. Sometimes they are planted along hedges and the boundary ridges of fields. The tract of country south and west of the Nabagunga abounds with large date gardens, particularly the line of country west of Magurah, where the land gradually rises higher and higher as we approach the confines of the Nuddea district.

South and west of Jhenidah the country may be said to be bristling with date trees planted in square plots of ten or fifteen beegahs, and these increase in number as we come nearer and nearer to the Kabadak. The line north of the Kumar, being subject to inundation, is not a well-planted date tract, the sugarcane having retained its hold there to some extent.

In October the side of the tree chosen for tapping is cleared of the leaves, and the bark just below the head is cut into, so as to form an oblong bare surface 15 inches by 12 inches, in proportion

to the circumference of the tree. After a week, when this surface is perfectly dry, its upper part is skilfully pared off, till the white and softer wood becomes visible. An indenture is then made in the lower part of the pared-off surface, along the sides of what appears to be an obtuse angle, with the angular point turned downwards. An inch below this point a split bamboo twig, seven or eight inches long, is inserted into the tree in order to conduct the sap into the juice pot as it oozes out of the white surfaces and passes in a thin slow stream through the two sides of the angle as it were through two drains. If there be not sufficient juice in the pared-off surface, it is left untouched for a week and cut anew after being well dried up. If the cut is deep before the surface is dry, the head of the tree pines away and the juice decreases in quantity. Careless insertion of the bamboo tube sometimes injures the young plant, which may cause its death.

Date trees are divided into three classes, according to their age:

(1) The *comra* or *chara*, or young plant, yielding from half to one and a half seer of sap in the first year, and two to three seers subsequently per night.

(2) The *majhari*, or middle-aged, called also *utit* or *nalgas*—a tree in the full swing of its juice-yielding career, supplying seven to nine seers per night.

(3) The *kakni* or *daria*, so named from its age and yielding its juice late in the season.

The trees are also classed as male and female—the former, which bears no fruit, yielding the sap early in the season, being called *chotna*; while the latter is called *baron*, bearing fruits and yielding the sap somewhat late. Middle-aged trees with robust heads yield the largest quantity of juice; the age at which it arrives at maturity being five or six years after the first tapping.

The trees of a date grove are divided into six portions (called *palas*) for the convenience of tapping them by turns, which goes on in the order described below. I should, however, mention here that the first night's juice is called *jeeran*, which is richer in quality and larger in quantity than that of subsequent nights, the second and third night's juice is called *dokat* (second cut) and *tekat* (third cut).

Juice collected in the fourth night is called *jhurrah*, and the day juice is called *ola*. The colder the night, the more the yield of the tree. Foggy and cloudy nights, which serve to decrease the cold of the weather, tend to diminish the sap. High winds dry up the moisture of the surface, and rain washes it off and lessens the sweetness of the sap. I have not been able to ascertain if the influence of the moon has anything to do with its increase or decrease.

Various artifices are resorted to in order to prevent thefts of the sap from juice pots, usually committed by boys at the commencement of the date season. The cutter puts slices of *kachari*, a species of poisonous *Arum*, *purmula* a nauseating leaf, and other pungent vegetables into the juice pots, in order to punish such night marauders who drink off the juice stealthily, and in the

morning the cutter's clamorously abusive language towards the female relatives of the young delinquents scares away the whole neighbourhood.

Early every morning the cutter (*gachi*) and his mate (*kheri*) go round from tree to tree, take down the pots, and collect the juice in order to be boiled down into *goor* (molasses). Boiling goes on in the date grove itself, or in some open space close by. A large stove called *bain*, with two to sixteen eyes, over which the boiling pans are placed, is fed by a strong fire. As the boiling goes on in earthen pans, the scum is taken off with a ladle formed out of a date branch, and green date leaves are put into the boiler in order to prevent overflowing. The bubbles which appear in the boiler mark the different stages of boiling, they are styled respectively spider (*makarsha*) bubbles, mustard flower (*sarsa fuli*) bubbles, tiger (*baghai*) bubbles, and treacle (*guria*) bubbles, which last indicate that the process is nearly complete. The boiled juice is then tested by pouring down a stream from the ladle. If it drops slow and thick, the pan is taken off the fire, and a small quantity of the boiled juice is triturated into powder on the margin of the pan and mixed up with its contents, when they all granulate and coagulate into *goor*. This process is known as *bijmara*.

There are three sorts of *goor* made from the date juice.

(1) The *patali*, or hard cake, which is used for local consumption, and sold at Rs. 2-8 to Rs. 3 per maund.

(2) *Khan goor* is the *goor* of commerce, called also *nagree*, locally consumed, but principally used in manufacturing sugar, sold at Rs. 1-12 and Rs. 2-2 per maund.

(3) *Ola* or *chitta goor*, prepared from the date juice—syrupy and devoid of granules; chiefly used in sweetening tobacco and manufacturing rum, and sold at 10 or 12 annas per maund. It is sometimes mixed up with *khan goor* as an adulteration.

Let us now see what is the actual produce of each tree, and the average income of the ryot from his date garden; although on this point no two accounts agree.

The tapping season generally extends from 5th Aghran (20th November) to 13th Fulgan (22nd February), over one hundred and ten days. From this we have to deduct foggy and cloudy nights, which may amount to ten in all during the season. The juice-yielding days amount therefore to fifty in all.

Now, counting according to the Bengali months, and taking the average produce month by month, as in the undermentioned table, we find the yield of a full-grown tree to be—

25 days of Aghran, at 2 seers per day	.. ..	50
29 " Pous " 5 "	.. ..	145
30 " Magh " 8 "	.. ..	240
15 " Fulgan " 3 "	.. ..	45
Total in 99 days	.. ..	480

Or deducting the days of rest, we have for fifty days 240 seers, which is equal to 24 seers of *goor*, 10 seers of juice being capable

of producing 1 seer of goor. The price of these 24 seers would equal Rs. 1-3 and Rs. 2 per maund.

Taking contingencies into account, the yield of a good tree may fairly be estimated at 12 annas a year. Both Colonel Gastrell and Mr. Westland calculate the average produce at 5 seers per tree, while the former makes the tapping nights sixty-five, and the latter sixty-seven. According to Colonel Gastrell's estimate the average yield of a tree is Rs. 1-2-6, which is very near my first estimate. Mr. Westland's estimate of each tree yielding one maund of goor, valued at Rs. 2 and 2-4, appears to be too high. Dr. Forbes Royle, in his work on 'The Fibrous Plants of India,' page 96, quoting from Dr. Roxburgh, states that each date tree on an average yields one hundred and eighty pints of juice, of which every twelve pints are boiled down to one of goor or jagri, and four of goor yield one of good powder sugar; so that the average yield of each tree is seven or eight pounds of sugar annually. Now taking a pint to be equal to $1\frac{1}{2}$ pow of Bengali liquid measure, each tree according to this calculation would appear to yield one maund and $27\frac{1}{2}$ seers of juice; and if 9 seers or 24 pints produce three-fourths of a seer of goor, we have $5\frac{5}{8}$ seers of goor as the average yield of a tree, which at Rs. 2 per maund would amount to 4 annas 8 pie per tree; this is a rather low estimate, looking to the fact that the expenses have yet to be taken into account.

The wood of the date tree is used as beams and posts in mat houses, and as ladders in tanks and ghats; it is also employed in constructing temporary bridges over khals and drains.

The leaves cut off before tapping season are used as fuel in the manufacture of goor, and answer the purpose a month. At Kaligunge *bedia patis* (leaf mats) are manufactured from the leaves and sewn into bags, into which sugar is put before being carried to Nalchith and other places. In the two subdivisions I have gone over, 4205 acres of land are occupied by date trees, exclusive of those growing all round the corners of ryots' houses. The approximate number of date trees in these two subdivisions is 1,033,825, or about two hundred and forty trees per acre. A beegah of land (one-third of an acre) is generally planted with one hundred trees; but as some of them die in the course of time, the above estimate is not beyond the mark. In both these subdivisions there are 2720 juice-boiling stoves or bains. For each opening in which a boiler is placed, the zemindar levies a tax of 1 anna 3 pie, and 6 pie for each of the side openings through which fuel is applied. Although the cultivation of the date tree has gone on increasing from year to year, on account of the increased demand for sugar, and the shipments made to Europe, still there are no accurate data available for the purpose of ascertaining the actual proportion of increase. In 1791 the annual produce of sugar cultivation was 20,000 maunds, of which half was exported to Calcutta. The increase in cultivation within the last century may be imagined from the fact that in the subdivisions of Jhenidah and Magurah alone, comprising as they

do only one-third of the district, the production was 391,780 maunds of goor, and 137,000 maunds (82 lbs.) of sugar in the year 1873, of which nearly 50,000 maunds were sent down to Calcutta. There is an extensive date cultivation in the subdivisions of Jessore and Nurrail, which has not been taken into account in this estimate.

Manufacture of Date Sugar from Goor.—The season for manufacturing powdered sugar from goor begins about the 1st of December, and terminates at the end of May, extending over a full period of six months.

The most important place in the district of Jessore with regard to the manufacture of sugar is Chandpur. The process adopted is easier than at first may be imagined.

The earthen jars into which the cultivator puts his goor are broken up by the sugar manufacturer, and the contents poured into a wicker basket, through which the scum oozes out below into a pan. On the fifth day, a river weed, called *patta seala*, found in abundance in the bed of the Bhyrab and Kabadak, is placed over the goor in the basket, and kept for eight days. When the seala dries up, it is thrown away, and the upper stratum in the basket, consisting of about 5 seers, is scraped off the surface. New seala is again put and kept on for eight days, and the above process repeated. In the second and third processes, the sugar is about 10 seers each time; in the fourth process the yield is 7 seers, and in the fifth 5 seers. In the last stage the yield is about 13 seers of inferior sugar. So from $3\frac{1}{2}$ maunds of goor $1\frac{1}{4}$ maund of sugar (sold at times at Rs. 10 per maund) is thus obtained.

The scum which has oozed and is called *mat* is again boiled, and sugar is manufactured from it under the above process.

The sugar thus obtained is called *dalua*—from its being produced in clods which are beaten and reduced to powder.

The manufacture of *schachi* (or real) sugar is carried on in the following manner:—Goor purchased in *tillias* (pots) is transferred into gunny bags, which are pressed betwixt bamboos in a hanging posture. The granular goor which remains in the bag is called *khar*, and the droppings—*mat khar*—are then boiled in a pan, mixed up with milk water, and passed through gunny and cloth sieves, and reboiled and transferred to semi-elliptical pots called *bharneas*, with a hole at the bottom. These pots are arranged over shelves and subjected to a course of seala refining as in the case of dalua sugar. The oozing during this process is called *mat goor*. When the second course of seala is put on, the droppings are called *jherani*, and so on. The process is repeated until the pot is well-nigh exhausted. The sugar produced is called (real) sugar No. 1. The *mat goor* of the bags and of the first refining process are boiled together, and become chitta goor. By boiling the *jherani goor* sugar No. 2 is produced by same process as the real sugar. Loaf-sugar or *dobara chini* is manufactured from the dalua or dullooah, which is boiled in water, and skimmed with milk. It is then put into an open earthen pot perforated

below. After the scum has dropped out two days, seala is placed on the surface of the sugar, and after eight days it arrives at its refined state. The droppings are boiled, and a kind of sugar inferior to the above, called *ekbara chini*, is manufactured from the same. The second droppings are again manufactured into a sugar called *petiar* (basket) sugar. In 1872, 170,000 bazaar maunds of sugar were sold off in the Chandpur market, of which 30,000 maunds were for consumption in the Mofussil.

The sugar made in Calcutta from the sap of the date palms has the following composition :—

	Per cent.
Cane sugar	87.97
Reduced sugar	1.71
Gum	4.88
Water and volatile matter	1.88
Ash	0.50
Mannite, fatty matter, undetermined and loss	3.06
	100.00

The reduced sugar contains glucose 1.53 per cent., and levulose 0.18 per cent.

THE PALMYRA PALM * (*Borassus flabelliformis*, Lin.) is one of those enjoying the widest geographical distribution. A glance at a map in Berghaus's or Johnston's Physical Atlas, showing the range of the most remarkable plants, will help to illustrate this fact.

In the Madras Presidency, sugar is extracted from the sap of the palmyra palm, and there are about 25,000 acres covered with this tree, chiefly in Bellary. The spadix or young flowering branch is cut off near the top, and an earthen pitcher tied on to the stump. The sap runs into this pitcher, which is emptied and replaced every morning after the stump has been again cut; and this process is repeated until the supply of the sap has been completely exhausted. Powdered chunam (lime), which has the property of preventing fermentation, is sprinkled on the outside of the earthen vessel in which the sap is collected. This juice is then boiled down, and the sugar obtained on drying the sediment by exposure. A tribe called Shanars draw the toddy or juice from the tree.

In Bengal the juice of the date palm, which is so much more abundant in saccharine matter, is preferred for the manufacture of sugar; though it is not apparent why, in parts of the country where the palmyra palm abounds, and the people do not drink toddy, its vinous sap is not utilized in the same way as in Madras.

In Ceylon there are nearly 40,000 acres covered with this palm, and there are 8,000,000 trees owned by people in the Jaffna Peninsula. There are about 70,000,000 nuts produced, and 20,000 cwts. of jaggery made from the sap.

* By W. Ferguson, of Ceylon.

The number of uses for which the palmyra is employed may be said to be almost infinite; indeed one of the eastern languages, the Tamil, spoken in a portion of the region which the tree acknowledges as its native country, possesses a poem entitled "Tala Vilásam," enumerating no fewer than eight hundred different purposes to which the palmyra may be applied, and this poem by no means exhausts the catalogue.

The spadix bearing the fruits is generally simple, and covered with a single sheath or spathe, as in the areca, catechu, and coconut palms, but it is sometimes compound, and bearing two bunches of fruit in a compound spathe. The fruits are, with beautiful regularity, arranged round the spadix in three rows, and whichever way examined are found in nearly opposite pairs. Each spadix bears from ten to twenty fruits, and one of these spadices, with the fruit ripe, would be nearly as much as a man could carry. Each palm bears seven or eight of these spadices, so that a tree often bears about one hundred and fifty fruits in one season; each fruit is about the size of a young child's head. The fruits, when young, are pretty distinctly three-cornered, but when old, the pulp round the nut swells so as to give the fruit the appearance of a perfect globe.

The ripe fruits or drupes contain two or three nuts imbedded in a mass of soft yellow pulp, intermixed with dark, straw-coloured fibre or coir. These nuts are oblong, and a good deal flattened, and covered with a mass of short fibre which adheres to them. Besides this fibre they are covered with a thick shell, so difficult of fracture that the Tamils say an elephant cannot break them.

The fronds are fan-leaved, armed with spines radiating from a common centre, and the stipes serrated at their edges. The fan part is about 4 feet in diameter. It answers as a kind of umbrella when held by the stem over one's head. The spines are cut off, and the middle is formed into large fans, called vissaries and punkahs. These are lacquered for sale, or used plain, as may suit the taste of the purchaser, but one never sees a Buddhist priest without one of the smaller sort, or a fan of some kind or other; of which some are heart-shaped, others circular, with handles of carved ivory.

The leaves of this tree, as well as those of the talapat tree, are used instead of paper by the natives. They write letters upon them, which, neatly rolled up, and sometimes sealed with a little gum lac, pass through the post-office. During the operation of writing, the leaf is supported by the left hand, and the letters scratched upon the surface with the stylus. Instead of moving towards the right hand, which performs the writing, the leaf is moved in a contrary direction, by means of the thumb.

All their olas or books, treating of religion, and the healing art, &c., are transcribed on them, but in a language elevated above the common idiom. The leaves of both these palm trees lie in folds like a fan, and the slips stand in need of no other preparation than merely to be separated, and cut smooth and even with a knife, after having been slowly dried in the shade, and rubbed

with oil. Their mode of writing upon them consists in carving the letters with a fine pointed style, and in order that the characters may be the better seen and read, they rub them over with an ink made of lampblack, or some other substance, and a solution of gum, so that the letters have altogether the appearance of being engraved.

The iron point made use of on these occasions, is set either in a brass handle, which the Moormen and others carry about them in a wooden case, and which is sometimes six inches in length, or else it is formed entirely of iron, and together with the blade of a knife, designed for the purpose of cutting the leaves, and making them even, set in a knife handle, common to them both, into which handle it shuts up, so that it may be carried by the owner about with him, and be always ready at hand.

On such slips all the letters and edicts of the Dutch Government used to be written, and sent round open and unsealed. When a single slip was not sufficient, several were bound together by means of a hole made at one end, and a thread on which they were strung. If a book had to be made for the use of the Wihares, or any other purpose, they sought for broad and handsome slips of talapat leaves, upon which they engraved the characters very elegantly and accurately, with the addition of various figures delineated upon them by way of ornament. All the slips had then two holes made in them, and were strung upon an elegantly twisted silken cord, and covered with two thin wooden boards. By means of the cord the leaves are held even together, and by being drawn out when required for use they are separated from each other at pleasure. In the finer binding of these kind of books the boards are lacquered, the edges of the leaves cut smooth and gilded, and the title is written on the upper board; the two cords are fastened by a knot or jewel secured at a little distance from the boards, so as to prevent the book from falling to pieces, but sufficiently distant to admit of the upper leaves being turned back, while the lower ones are read. The more elegant books are in general wrapped up in silk cloth, and bound round by a riband, in which the Burmese have the art to weave the title of the book. The palmyra books are never much beyond 2 feet in length, and 2 inches in breadth, as the parchment-like ribs between the little ribs will not admit of their increase in size.

Narrow strips of the leaf are braided into sieves, hats, and caps, baskets, mats, and bags; the baskets are used for drawing water as well as other purposes, and the bags not only for carrying rice, salt, &c., in small quantities, but for storing grain, being made very large and strong, while the mats are necessary for the natives, not only to sit, eat, and sleep on, but for drying various kinds of fruit, treading out grain, and many other purposes. On the stem of the leaf is a very hard and strong covering, like that on the bamboo or rattan, which, slit off, is formed into coarse, strong ropes.

Each tree has from twenty-five to forty fresh green leaves upon

it at a time, and of these the natives frequently cut off twelve or fifteen annually, or a greater number once in two years, to be devoted to various purposes, as well as to enable the fruit to ripen and increase in size. When the leaves are intended for thatch, or for making fences, they are placed flat on the ground in layers over each other, and often with weights upon them to assist in the process of flattening them. The thatch formed of these does not last longer than two years, nor is it so handsome as that made from the plaited cocoanut leaves. The leaves make very close and elegant fences.

Toddy.—At the season when the inflorescence begins to appear, when the spathes have had time to burst, the “toddy drawer” is at work in the palmyra groves. His practised eye soon fixes on those trees fit for the “scalping knife,” and if they have not dropped the foot-stalk of the leaves, the first operation, if the trees are valuable, is to wrench them off. This done, the toddy drawer, armed with his leathern protector for his breast, his raceme-batten of wood, his small thongs, straight and crooked knives, with the side leather pouch to contain them, procures a piece of tough jungle vine, or a strip of the stalk of a young palmyra or coconut tree, which he converts into a sort of loop, of such dimensions as to admit of his feet getting through to a space large enough to allow them to clasp the tree. This done, he puts his feet in this thong, stands close to the tree, stretches himself at full length, clasps it with his hands, and pulls his feet up as close to his arms as possible; again he slides up his hands, and repeats the process, until, by a species of screw process, he ascends to the summit of the tree. An expert climber can draw toddy from about forty trees in a few hours. In Jaffna a distinction is made between toddy and sweet toddy; the former, called by the Tamils “culloo,” is the fermented, the latter the unfermented juice. Toddy serves extensively as yeast, and throughout Ceylon no other is employed by the bakers; large quantities of it are also converted into vinegar, used for pickling gherkins, limes, the undeveloped leaves of the coconut and palmyra trees, and other substances; but by far the greatest quantity is boiled down for jaggery or sugar. About 1000 tons are said to be manufactured of it in Ceylon.

According to Forbes, three quarts of toddy will make 1 lb. of jaggery. Malcolm remarks that jaggery resembles maple sugar, and that in the neighbourhood of Ava 1 lb. sells for the third of a penny. In Jaffna 3 lbs. are sold for 2d. The usual process of making jaggery, as pursued at Jaffna, is exceedingly simple. The sweet toddy is boiled until it becomes a thick syrup, a small quantity of scraped coconut kernel is thrown in that it may be ascertained by the feel if the syrup has reached the proper consistency, and then it is poured into small baskets of palmyra leaf, where it cools and hardens into jaggery. In these small plaited palmyra baskets it is kept for home consumption; sent coastwise, chiefly to Colombo, or exported beyond seas to be refined. To make vellum or crystallized jaggery, which is

extensively used as a medicine, the process is nearly the same as for the common sugar, only the syrup is not boiled for so long a period.

The pot which contains it is covered and put aside for some months, at the end of which period the crystals are formed in abundance. The juice of the palmyra is richer in saccharine matter than that of most other palms, in consequence, perhaps, of the tree more generally growing in dry sandy soil, and in a dry climate. The great fault of the jaggery made at Jaffna seems to arise from the too free application of lime, a small quantity of which is absolutely necessary to prevent fermentation. Jaggery forms an article of commerce from the upper to the lower provinces of Burmah, and is also of importance in some of the islands of the Indian Archipelago. Besides being exported in large quantities from Ceylon, it forms a considerable portion of the food of the Tamil people of Jaffna. Amongst a variety of purposes to which it is put, is that of being mixed with the white of eggs, and with lime from burnt coral or shells. The result is a tenacious mortar, capable of receiving so beautiful a polish, that it can with difficulty be distinguished from the finest white marble.

Timber.—A full-grown palmyra is from 60 to 70 feet high, its trunk at the bottom is about $5\frac{1}{2}$ feet in circumference. The wood is generally known in Ceylon and the maritime ports of India. Large quantities of it are exported from Point Pedro, and other ports of Jaffna, to Madras and Colombo. At certain seasons of the year the felling, splitting, dressing, and exporting of it give work to thousands of the Tamil people of the northern peninsula of Ceylon. The trees have to arrive at a considerable age before they are of use for timber; when a hundred years old they are excellent. The wood of this palm near the circumference, when of sufficient age, is remarkably hard, black, heavy, and durable, and universally used for rafters in pent-roofed houses, for which purpose Roxburgh states it is the best wood in India. The centre is soft and spongy, containing little else than a coarse kind of farinaceous matter, intermixed with some soft, white woody fibres, and is cut out, as the black exterior hard part only is employed. The wood is capable of taking a fine polish. Its specific gravity is, according to Mr. Mendis, 65 lbs. per solid foot. For house building, and various domestic purposes, the timber is the most generally used of the palm tribe. Pillars and posts for the verandahs of houses, well sweeps, joists, and reepers, or laths, &c., are made from it. The trunk is split into four for rafters, into eight for reepers or laths, and these are dressed with an adze. From the structure of the fibres, it splits easily in the direction of its length, but supports a greater cross strain than any other wood; iron nails, however, will rust rapidly in it.

Palmyra trunks split into halves, with the heart scooped out, are used as spouts for various purposes, but more especially for carrying away the water from the eaves of houses. The dark

outside wood of very old trees is used to some extent in Europe for umbrella handles, walking canes, paper rulers, fancy boxes, wafer stamps, and other articles.

Kelingoes.—The nuts are collected and buried in heaps in the ground. When dug up after the space of three months, the young shoots called “kelingoes” supply the inhabitants with a nourishing aliment. In size, colour, and shape they resemble a parsnip, and look like a cold potato. In its fresh state it will keep good for a couple of months, and when well dried in the sun, for a whole year.

In this state they are called odials. When reduced to flour or meal, the favourite cool or gruel is made of it.

Punatoo.—The pulp of the fruit is preserved for use in the following manner :—The ripe fruits are put into baskets containing water, and are then squeezed by the hand till the pulp forms a jelly. Layers of this jelly are spread on palmyra leaf mats to dry on stages. Layer after layer is deposited to the number of about fifteen. These are left in the sun about a fortnight or three weeks, only covered at night, and protected from the dew and rain. The best sort is called Pimatos, and the tough withery kind made from the remaining fruits gathered at the end of the season, which is much in favour, Tot Punatoo. Punatoo is sold by the mat at 3s. to 6s. each, and is the chief food of the islanders of Ceylon, and of the poorer classes of the peninsula, for several months of the year.

THE SAGO PALM (*Sagus Rumphii*, Willd.; *Sagus genuina*, Rumph.; *Metroxylon Sagus*, Koen.) is a tree from which the inhabitants of the eastern portion of the Indian Archipelago derive the farinaceous nutriment which other nations of the world obtain from cereal grains or farinaceous roots. For the natives this palm is a source of vegetable food more abundant and less variable in its yield than rice.

After the Nipa, the Sago is in stature the smallest of the palm tribe, its extreme height seldom exceeding thirty feet, but it is the thickest, except the Gomuti (*Arenga saccharifera*), and a full-grown tree can with difficulty be clasped between both arms. In the early period of its growth, and before the stem has formed, this palm appears altogether like a cluster of so many shoots. Until the stem has attained the height of five or six feet, it is covered with sharp spines, which afford it protection from the attacks of the wild hog, or other wild beasts. When, from the strength and maturity of the wood, this protection is no longer necessary, the spines drop off. Before the tree has attained its full growth, and previous to the formation of the fruit, the stem consists of a thin hard wall, about two inches thick, and of an enormous volume of a spongy, medullary substance. This medullary substance is the edible farina, from which the inhabitants of the Archipelago make their bread. As the fruit forms, the farinaceous pith disappears, and when the tree attains full maturity the stem is no more than a hollow shell. The utmost age of the tree does not exceed thirty years. The sago palm loves low, marshy situations, and will not

flourish on dry or mountainous places. Rumphius says :—"This tree grows best in miry or watery soil, where men sink to the knee in mud. It will also grow in gravelly soil, if only it is charged with moisture, and hence no plantation of the sago tree will thrive where there are not one or more rivulets of water." A bog knee-deep is consequently the best site for a sago plantation. There are three well-marked varieties of this palm, namely :—

(1) The cultivated, *S. Rumphii*, spinous, both on the trunk and leaves. (2) The wild. (3) One distinguished by the length of the spines on the branches. Another species destitute of spines (*S. lœvis*, Reinw.; *S. inermis*, Roxb.), and usually called by the islanders the female sago, is grown in Java, Sumatra, Celebes, Borneo, Malacca and Siam. Each tree yields about 5 piculs (about 600 lbs.) of pith.

The first and last varieties yield the best farina; the second a hard pith, from which the farina is extracted with difficulty; while the third, which has a comparatively slender trunk, contains but a small quantity of farina. The sago, like other palms, is propagated from the seed or fruit, which is of inconstant shape and size, from a prune to a pigeon's or pullet's egg.

The sago and nipa palms furnish in the Amboyna Isles a wholesome and abundant nourishment, for a basket of their fruit will support seven or eight persons for a week. A good tree will furnish thirty baskets as an average harvest; the fruits keep well in water.

The sago of the Arenga palm is more palatable than that of the sago palm, but the culture involves more care, and the product does not keep so well.

The word *sagu* is said to be the Malay name for bread or meal.

Sago meal is eaten by the natives in the form of pottage, and also partially baked in earthenware moulds into small square biscuits about two inches long, two broad, and half an inch thick, which will keep a considerable time. Large quantities of the sago meal in its raw state are received at Singapore from the Eastern Islands to be granulated or pearled and bleached for shipment to Europe.

Sago is much used during their sea voyages by the natives; it is cooked by simply dipping the cake in warm water, which softens it; it is also sometimes made into soup.

The sago tree is found, in one or other of its species, throughout the whole length of the Eastern Archipelago, from the islands off the west coast of Sumatra to New Guinea. It is probably capable of flourishing with complete vigour across nearly the entire breadth, wherever its natural soil occurs, and certainly within 10° north and south of the equator, a band which includes all the Archipelago, except the Philippines. The only countries, however, where it is found growing in large forests are, New Guinea, the Moluccas, Celebes, Mindanao, Borneo, and Sumatra, being widely spread over the Moluccas, but confined to particular parts of the others.

The native country of the sago palm appears to be that portion of the Archipelago in which the easterly monsoon is boisterous and

rainy. It is most abundant in the islands distinguished for the production of the clove and nutmeg, and is to be found in its wild state in immense forests. Of all the plants which afford a supply of nutritious farina for human food the sago is at once the most obviously easy and abundant. The mass of nutritive matter which a single tree yields is certainly prodigious. Five and six hundred pounds weight, it appears, is not an unusual produce for one tree.

Allowing for destroyed, barren, and unproductive trees, the average weight of produce may be assumed at 300 lbs. avoirdupois.

Forrest states the average produce of a *Molucca* tree to be 336 lbs., but Rumphius makes it from 600 lbs. to 800 lbs.; and according to a writer in a Singapore paper, good Sumatra trees yield from 760 to 950 lbs., and the very worst 475 lbs. Perhaps, therefore, 700 lbs. may be assumed as an average for the Sumatra trees, which at 10 feet apart (the distance stated by Forrest and followed by Crawford) would give 300,000 lbs. for the harvest from one acre; and allowing that the trees are fifteen yards apart, and not seven as Forrest assumes, this will give an annual average produce of 20,000 lbs. I believe, however, that five or six feet is about the average distance of the large stems in the Sumatra forests. When a plantation has once arrived at maturity there will be a constant harvest, because the natural mode of growth secures a constant succession of new plants from the time those first planted have begun to extend their roots, and the succession can be regulated by the knife in any way the planter desires.

There is no regular fixed season for extracting the pith, which is taken as occasion requires and as the individual tree becomes ripe. The period of maturity depends on the nature of the soil on which the palm grows. Fifteen years may be reckoned an average time for the tree to come to maturity. It is not, however, by a calculation of the tree's age, but by its appearance, or by an actual experiment on the pith, that the period of maturity is determined. The inhabitants of the Moluccas mark six stages in the progress of the ripening process of the medullary substance, the first of which is known by the appearance of a mealy efflorescence on the branches, and the last by the commencement of fructification. The pith may be extracted at any of these stages; and sometimes the natives, trusting to their experience, proceed to the harvest from the mere appearance which the tree presents. More frequently, however, a hole is bored in the trunk and a small quantity of the pith extracted for the purpose of ascertaining the degree of its maturity. When the pith is ascertained to be ripe, the tree is cut down near the root and the trunk subdivided into portions of six or seven feet long, each of which is split into two parts; from these last pieces the medullary substance is extracted and at once reduced to a powder-like sawdust with an instrument of bamboo or hard wood. The process of separating the farina from the accompanying bran and filaments is simple and obvious, and consists merely in mixing the powdered pith with water and passing the water charged with the farina through a sieve at one end of the trough in which the

mixture is made. This water is again passed into a second vessel, where the farina settles down to the bottom, and, after two or more washings, is fit for use. This substance is the raw sago meal, which keeps without further preparation for a month. For further use the meal is made into cakes, which remain sweet for a long time. But for exportation the finest sago meal is mixed with water, and the paste is rubbed into small grains of the shape and size of coriander seeds.

Considering that after cutting down the tree new suckers are sent out from the root, which in their turn render a harvest, and that the culture requires little care, it must be admitted that this palm is for the natives a vegetable food more rich and less variable in its produce than rice.

The sago palm is grown in different parts of the Indian continent as an ornamental tree; and as it is easy of propagation and not difficult to cultivate, it might be of advantage to the country if private enterprise would set on foot plantations of this valuable tree in suitable localities in the plains of India.

In *Borneo* the sago palm is found thriving along the north coast at Kaluka, Oya, Muka, and Bentulu. It is cultivated chiefly by the Millanu population. This tree requires eight years to attain its full growth; it is then cut down and the heart of it extracted. One tree produces about 600 lbs. of raw sago, which, after being washed and dried, gives 300 lbs. of sago flour. During its growth it throws out numerous shoots, which are capable of being transplanted, and thus a plantation is easily increased. The quality of the Sarawak sago flour is considered to be exceedingly good.

There are now several sago factories at Sarawak, all belonging to Chinamen, and worked solely by manual labour. The number of hands employed in each of these is from thirty-six to forty, who manage to turn out 7000 lbs. to 8000 lbs. of sago daily.

The raw sago is brought down by natives from the interior to Brunei, and is there washed and undergoes a refining process before being shipped. The labour employed in the washing and manufacturing process is exclusively Chinese; and the three sago-manufactories in Brunei were established by and belong to Chinese-traders.

Whether this palm is an indigenous plant, or whether it was originally introduced and cultivated, is perhaps a question; but so abundant is its natural growth, that so long as it was only required for native consumption there was never any occasion for its cultivation. The palm grew wild and in luxuriance, and trees were cut down whenever required. With the increasing demand by foreign markets for sago flour, the inhabitants of the more accessible and more populous districts have been induced to extend the existing area of the natural growth of the palm, by planting new ground with young shoots. No further cultivation is required. Once planted, the young shoot in about seven years becomes a tree of sufficient maturity for the extraction of the medullary pith out of which the sago flour is made, and already propagating itself by sending out fresh shoots in all directions.

Two kinds of this palm are known in Borneo, *Sagus* or *Metroxylon lævis*, the spineless species, and *Sagus* or *M. Rumphii*, the trunk of which is armed with long and strong spikes, tending to preserve it when young from the attacks of the wild hog, which abounds in all parts of Borneo. This palm attains a height of from twenty to forty feet, and grows in vast forests, in swampy land, along the banks of rivers, not far from the coast. Just before the terminal spike of flowers appears, about 6 or 8 years from the time of planting, the palm is cut down at the root, divided into lengths to suit the manipulator, and each length split in two, when the pith is scooped out by means of bamboo hatchets, a thin outside skin or rind being all that is left. The pith is placed on mats over a trough by the river side, and water being constantly poured over it, it is trodden out by the feet of the natives, a rough separation of the starch from the woody matter being thus effected, the former running off with the water into the trough below, while the latter remains on the mat, and is thrown away or used as food for pigs. The sago, known then as *Lamunta* (raw) is sold to the Chinese, by whom it undergoes further cleaning by means of frequent hand-washing in troughs, and is then packed in gunny bags and exported to Singapore. There it is either converted into the pearl sago sold in the shops, or is sent direct to Europe as flour for use in sizing cloths, the manufacture of beer, preparation of confectionery, &c. The sago flour, boiled into a paste (*boyat*) is largely used as food in the place of rice in the districts where it flourishes, but rice, when it can be afforded, is preferred. If the palm is allowed to flower and seed, the pith of the centre is found to be dried up and useless, and the tree dies.

As each parent tree is surrounded with young ones which ripen in due succession, a sago plantation once made will never be exhausted; returns, however, should begin to come in six or seven years, and not ten; but the chief objection to sago planting is undoubtedly the length of time that elapses before the plantation is in full bearing.

Mr. W. M. Crocker furnishes an estimate of the cost of planting this palm on a large scale in Borneo, where the cultivation is at present in the hands of the natives, and yet they supply seven-eighths of the sago brought into the European markets. His estimate of the probable cost of and profits of a plantation of 2,000 acres is as follows:—

On 2,000 acres 100,000 trees could be planted, the total cost at the end of ten years from the first start including interest would be £17,280. The plantation would then be ready to produce 30,000 trees annually. And for a yearly outlay of £6,950 there would be a net return of £22,500, leaving a profit of £15,550 per annum. Nothing is charged for the land, as the Directors of the North Borneo Company have it at their own disposal.

In Celebes all the inhabitants feed upon sago of a very coarse quality, which may be said to grow spontaneously, affording them abundance of subsistence. The sago plantations are situated in the valleys between the mountains, in swampy ground. There are

several kinds of sago tree, some of which will not produce any useful fecula or starch for the first 16 years. It is collected from trees of 8 years up to 32 or 35 years of age, after which the tree becomes perfectly hollow, and rots away from the top downwards. A sago tree of 10 years' growth will be about 27 feet high, and from 5 feet to 8 feet girth at the bottom, and is continually yielding its crop. When the substance of the edible sago is 3 inches to 5 inches thick they cut it, and this will be in two or three months, according to the nature of the soil; and the oftener it is cut the faster it grows.

There were in 1874, in the district of Tonsawang, Menado, 353,600 sago palms, and their produce was about 2500 piculs of sago; the price of the raw sago was half a florin the picul, and of purified sago two and a half florins the picul. There were in Billiton in the same year 20,630 sago trees. The produce of sago in Riouw is about 57,700 piculs.

These palms are found in every part of the Malayan Archipelago and Philippines as far as Mindanao, wherever there is a genial soil for them, and this consists of a marsh or bog, composed of decayed vegetables, near the sea. They are most abundant in the eastern parts of the Malay Archipelago, at the Moluccas and neighbouring islands, with New Guinea and Borneo, and in the Philippines at Mindanao. In all these sago is more or less the bread of the inhabitants. These palms propagate themselves by lateral shoots as well as by seed, and they die after producing fruit. From the first of these properties it follows that a sago plantation once formed is perpetual.

The sago tree, when cut down and the top severed from it, is a cylinder about 20 inches in diameter, and from 15 feet to 20 feet in height. The contents would, therefore, be nearly 26 bushels, and allowing one-half for woody fibre, there will remain 13 bushels of starch, or say 700 lbs.

It may give some idea of the enormous rate of this produce, if it be considered that three trees yield more food-matter than an acre of wheat, and six times more than an acre of potatoes. An acre of sago, if cut down at one harvest, will yield 5220 bushels, or as much as 163 acres of wheat, so that, according as we allow seven or fifteen years for the growth of a tree, an acre of sago is equal in annual produce to 23 or 30 acres of wheat. It is far from being either so palatable or nutritious as it is prolific, and is never preferred, even where it is most abundant, to rice.

Singapore is at present the chief place of manufacture and principal mart for granulated sago and "sago flour," as it is termed in commerce, but which is, in fact, the fecula, or ungranulated starch. The granulated fecula, or sago, of a dirty brown colour, used to be exported from the archipelago in small quantities, but when the trade in Europe was thrown open, in 1814, the Chinese of Malacca began to prepare a superior starch, known in commerce under the name of pearl sago.

All the raw sago manufactured at Singapore is brought from islands to the eastward, principally from the north-west coast of

Borneo and the north-eastern part of Sumatra, with its adjacent isles, from Siak to Indragari, but a considerable portion comes from places more than 1000 miles distant.

This article is very easily prepared for exportation in its raw state; the tree is cut down, then the cellular tissue is taken out and made up into bundles. In this form some 18,000 or 20,000 tons are annually imported at Singapore, where it is prepared by the Chinese, who clear the meal or farina from the fibres of the cellular tissue, when the flour is either made up for exportation in its natural state, or granulated into pearl sago.

Manufacture of Pearl Sago in Singapore by the Chinese.—The tampins or leaf bags of sago having been placed in heaps in the shed, the first step is to open them, cast the contents on an inclined plane, about 12 feet square, surrounded by a rim rising about 2 inches from the surface; the sago, massed together by having remained compressed in the tampin, is here broken up by the common *chäutzäl* (a kind of hoe).

The raw sago having thus been made ready for the manufactory, the first process to which it is subjected is that of a thorough washing, without which it would remain impure and coloured. For this purpose strong tubs are employed, about 12 inches deep, 40 inches in diameter at the top, and 6 inches or more at the bottom; they are bound by three hoops, each formed of about six rattans twisted together. A piece of thin coarse cloth is fastened by its four corners over each tub when used, and hung loosely into it. The moist sago being poured into this strainer, and there broken and bruised by the hand, is agitated until all its fine particles pass through the cloth and descend to the bottom of the tub, while the fragments of leaf, fibre, and other impurities which remain in the cloth are shaken into a rude mass, which is taken up in a bowl and thrown aside. The rapidity and deftness with which this and all the other manipulations are performed are very striking. The sago is next stirred with an oar for about an hour, after which it is left to stand for twelve hours, when the water is ladled out, and the sago, which fills about half the tub, is removed to undergo the last purifying process which precedes the granulation. This is performed in a mode at once simple and ingenious, the same principle being availed of which serves the gold and tin miners of the Archipelago to clean the ore; the more precious matter happening in all three cases to be heavier than that with which it is mixed, and being thus readily separable by the action of running water.

Two tubs are placed at a distance of 10 or 12 feet from each other, and connected by troughs, raised by a framework above them. These troughs are about 10 inches deep, 14 inches broad at the top and 11 inches at the bottom, one end being closed and the other open, but having grooves in their sides and bottom, like those of a sluice, into which a series of horizontal pieces of wood or stick fit, each being about three-eighths of an inch in thickness. The end of a piece of cloth, of the breadth of the trough, being placed over the groove at the bottom, the shortest of the sticks is

pressed down upon it, and the cloth, thus fastened, is made to hang down over the edge of the trough into the tub below it. The tub at the after end now receives the sago to about two-thirds of its depth, when it is filled up nearly to the top with water. A man now stirs up a portion of the sago with an oar till the water attains a milky appearance, when he proceeds to pour it into the troughs. To prevent its falling abruptly an inclined piece of wood, 8 inches broad, is fixed across the trough, so as to leave only a narrow slit between it and the end of the trough. The water poured on this descends into the trough, and slowly flowing to the other end deposits a portion of the sago in its progress. The suspended cloth, becoming saturated, serves at once to maintain and equalise the overflow of the water into the tub below it. When the water is poured in the first waves advance rapidly and carry away much of the sago, but those that succeed deposit the greater part of their more solid contents, transporting into the tub only the lighter fibrous particles which it is the object of this operation to separate from the farina, and by the time the man has performed a similar service at the other trough, and is ready to pour a fresh supply into the first, the water flowing down the cloth has lost its whiteness. This process is continued until the deposit rises nearly to the level of the stick, when the sago next to it, which generally contains some impure sediment, is taken up with the fingers or thrown into the tub. The second stick is now fixed above the first, a fold of the cloth being interposed between them to prevent any liquid sago escaping through the seam, and the operation goes on as before. When the milk in the upper tub begins to grow shallow it is again filled up with water and more sago stirred up and mixed with it. During the interval and at other more prolonged interruptions, the water in the troughs has had time to deposit all its contents, the last being a fine fibrous matter, which, if not run over, would leave a thin yellow layer. The surface is therefore washed with the hand until this layer is effaced and held in suspension. When the troughs have been gradually filled up in the manner described, by a succession of deposits, and the wall built up to the top by the last stick, the sago is left to consolidate for twelve or fourteen hours. The fecula which passes out of the troughs in the current is afterwards thrown into one of the tubs, whose contents are to be washed and deposited in their turn, and some of it may even be destined to pass through the process many times before it sinks in the trough.

In order to give it the degree of dryness required, it is exposed for one day to the sun, in lumps about a cubic foot in size, which are placed on tables standing in the open air. Large kagans (or mats) are kept in readiness to cover it when a shower of rain falls. It is next carried to the large shed, where it is thrown in a heap on a long table and broken down into a pulverulent state. It then passes through an oblong sieve, 30 inches by 20 inches, of which the bottom is formed of parallel fibres from the stem of the coconut leaf, kept in their position by strings, which cross them at distances of about 2 inches. The lumps which do not pass

through the long interstices between the fibres are thrown back into the heap.

The granulation or *pearling* now takes place. The sifted sago is placed in a cloth, of which the ends are tied to a long stick, and that is kept expanded in a bag-shape by a short cross-stick. A horizontal vibratory motion is given to this, the whole mass being kept in constant agitation and every part successively driven along the sides of the bag. This lasts for about a minute, when the now granular sago is again passed through a sieve similar to the preceding one, but the smaller grains which pass through are those which are rejected. Those that remain are transferred to a circular sieve, of which the bottom is formed of fine strips of bamboo crossing each other. The grains which pass through the square holes thus produced form the pearl sago of commerce in the unroasted state. Those that are larger than the holes are thrown back into the heap to run through the same course again. To assist the men the oblong sieves and the granulating bag are sometimes suspended by rattans from the rafters of the shed.

The roasting takes place in a row of iron pans, each about $2\frac{1}{2}$ feet in diameter, which are built into a platform of masonry about 15 feet long and 4 feet in breadth, covered with flat tiles. The pans rest in an inclined position, partly against the back of the platform, which rises about a foot above the level, and partly on a small prop of brickwork on the right side, an offshoot from the wall. Into the top of this prop a plate is sunk in which a cloth saturated with water is kept. Behind each pan is an open furnace mouth, and a man constantly attends to the fires, keeping them supplied with a few billets of hakan wood, and regulating them with a two-pronged iron fork, so as to maintain a moderate heat. The pan being gently rubbed with the cloth, a man who sits in front of it on a low stool on the platform pours into it a quantity of granular sago. This he slowly stirs for a short time with a wooden implement, called *weah*, having a sharp curved edge. More sago is poured in until it amounts to about two *chupahs*, when as it hardens he uses the *weah* more freely. After about three minutes' roasting it is removed to a table and passed through a round sieve, similar to that before described. The grains that adhere to each other are thrown aside, and those that pass through form a smoking heap, which is allowed to lie undisturbed for about twelve hours. The grains are about the same size as they were before roasting, and some retain wholly or partially their white and mealy appearance, but the greater part have become translucent and glutinous, and all have acquired a certain degree of toughness, although still soft. The final process is another roasting, which renders them hard and tough, and greatly reduces their size. The pearl sago thus prepared and fit for exportation, is put away in large open tins ready to be transferred to boxes or bags when sold.

The imports of sago have steadily increased in England since the abolition of the duty which was formerly levied.

In 1830 the import and consumption of sago in the United Kingdom was only 3000 cwts.; in 1841 it was 52,000 cwts.; in 1850, 90,000 cwts.; in 1860, 179,825 cwts.

The following figures give the imports of sago into the United Kingdom from the Straits Settlements:—

	Cwts.		Cwts.
1862	165,635	1875	350,064
1863	123,870	1876	338,230
1864	111,423	1877	339,882
1865	106,409	1878	338,588
1866	151,788	1879	336,827
1867	142,844	1880	381,668
1868	241,860	1881	410,137
1869	268,978	1882	315,679
1870	268,666	1883	333,335
1871	227,766	1884	345,902
1872	288,862	1885	362,035
1873	279,766	1886	470,045
1874	300,299		

The chief uses of sago are for feeding stock, making starch, and by the cacao manufacturers for grinding up and giving thickness to their product when consumed.

THE BASTARD SAGO (*Caryota urens*) is a native of the mountainous regions of India, especially on the Coromandel and Malabar coasts, and in Travancore, Mysore, and Ceylon. In Ceylon about 30,000 acres are covered with this palm. It is one of the largest and most charming of this beautiful tribe, having a straight trunk from 40 to 60 feet high. Sugar and toddy wine are both prepared from the sap of this palm, which is cultivated by the people for those uses. The best trees will yield 100 pints of sap in twenty-four hours; and it is on account of this productiveness that it is so much valued. The sugar and wine are obtained much in the same way as from the juice of other palms.

Sago is prepared from the pith, and is either made into bread or boiled as a thick gruel. According to Dr. Roxburgh, "the pith or farinaceous part of the trunk of old trees is said to be equal to the best sago. . . . I have reason to believe this substance to be highly nutritious. I have eaten the gruel, and think it fully as palatable as that made from the sago we get from the Malay countries."* The sago is found to be an efficient substitute for the staple food of the countries where it is produced, during periods of famine.

A fibre is prepared from the leaves of this palm, which is used for fishing lines and bowstrings. Commercially, it is known as kittool fibre and Indian gut in the English market. It is strong and durable; though it will resist the action of water for a long time, it is yet apt to snap if suddenly bent or knotted. It is now used in brushmaking. During late years the trade in this

* Roxburgh's 'Flora Indica,' vol. iii. p. 626.

staple in England has been small for want of stock; the price in London in July 1888 was for good extra long, 11*d.* to 1*s.* per lb.; good, No. 1, 9*d.* to 9½*d.*; common, 5*d.* to 6*d.* In 1883, 1762 cwt. of kittool fibre were shipped from Ceylon, and in 1886, 2996 cwt. In Ceylon the split trunks are used as rafters, and are found very hard and durable. The fibre of the leaf stalks is made into ropes, and used for tying wild elephants. The woolly substance found at the bottom of the leaves is employed occasionally for caulking ships. According to Buchanan, the trunks of this palm are the favourite food of elephants. The fruit, which is about the size of a plum, has a thin yellow rind, very acrid, and if applied to the tongue will produce a burning sensation. Hence the specific name of the tree. The seeds are used by the Mahomedans as beads.

Another misnamed sago palm is the *Cycas revoluta*, Willd., a native of Japan. It is in that empire grown in plantations around the houses. The seeds are eaten, and an inferior kind of sago made from the central stem, whence it has received the name of sago palm, although the true sago, as we have seen, is the product of the *Sagus Rumphii* palm.

Sago is easily obtained from the interior part or trunks of these trees. The process consists in pounding the spongy or cellular texture of the stem—sometimes erroneously called the pith—and washing it with water, which is strained, to separate the ligneous fibres from the fecula. Sago is grained by moistening the flour and passing it through a sieve into a shallow iron pot that is suspended over a fire, by which means it assumes a globular form. In consequence of being half baked during the process of granulation, it may be kept a long time without undergoing a chemical change.

According to Dr. Hamilton, a kind of sago flour is prepared from the nuts of *Cycas circinalis*, which is much used by the poorer classes of natives and forest tribes of Malabar and Cochin. The nuts are dried in the sun for about a month, pounded in a mortar, and the kernel made into flour.

THE CARNAUBA PALM.—This Brazilian palm (the *Copernicia cerifera*, Mart.) is but little known beyond the locality where it grows, but its many useful products demand for it a more extended notice. It is most extensively found in the province of Ceara, although it is met with in several others of the northern districts of Brazil, either isolated or aggregated in immense forests. The stem (stipe), completely round and straight, attains the height of 48 feet, and a thickness ranging between one foot and one foot and a half in circumference. The upper part of the stem contains a medullary substance (parenchyma), which gives forth the leaves. The terminal bud (palmetto or cabbage palm) furnishes a delicate and substantial food. In springing from the head of the stem, the leaves, to the number of six or eight, cross each other perpendicularly, united together by a mastic or coating which holds them firmly together. The petioles remain separate, but the leaves

re-unite at the top and form a round fringed body. The interior of the young groups of leaves is clear yellow. At this stage of their development, the leaves transude a dry pulverulent ash-coloured substance, which covers their interior surface and exhales a particular but agreeable odour. This substance is a vegetable wax; it is detached from the leaves by the least shock when they begin to open, but, when the fan is expanded, the simple movement produced by the wind is sufficient to cause this powdery substance to disappear. The carnauba palm delights in dry localities, or, at least, ground which remains dry the greater part of the year; and yet it will stand perfectly the prolonged inundations of water, provided that they do not cover completely the whole lower part of the trunk. At Ceara and the surrounding country, where it never rains for six months in the year, that is in the season called spring by the natives, the carnauba pushes forth its most vigorous strength when the season is dry and destitute of water. At the time of the greatest aridity and desolation, corresponding with the winter of the temperate zones, forests of carnaubas flourish, blossom, and ripen their fruit. This singular plant is so proof to heat that it can support without injury the action of fire, for the flames, which may destroy the useless parts, only make it grow more vigorously subsequently. In the times of the greatest drought, the people give themselves up with ardour to the collection of the products from the carnauba, which in those periods yield new and increased resources. The most important of these products is the wax. Early in the century, Manuel Antonio di Macedo discovered at Ceara the carnauba wax. But, although he pointed out the means of obtaining the wax, no persons appear to have occupied themselves about it. It would seem that the discovery dates before 1810, for it was in this year, and after the description of the botanist Arruda, that it commenced to be known, and to produce a certain impression of novelty. The Brazilian authorities were not slow to give to it the importance it merited.

The greater part of the wax obtained is used in Brazil, where it is employed in its raw state for lighting. In making it into candles, a small quantity of tallow is added. No one is seriously occupied in the scientific improvement of this product, which might become an article of considerable commercial importance. Meanwhile, a few makers of candles from carnauba wax at Ceara, have recourse to certain processes by which they obtain a slightly improved product, but in general the candles made of it in Brazil are of a very inferior quality. They are mostly used for household purposes, especially for lighting kitchens—in fact, these candles produce the cheapest light that can be obtained. In comparing their illuminating power, the advantage is chiefly in the extraordinary duration of these candles, as the price is not higher than that of those made with other materials. Candles made with carnauba wax in the crude state, give off in burning a perfume which is not disagreeable. This wax received little attention till after 1846, resulting from the great drought of the previous year.

The following gives the exports from the port of Ceara for a few years :—

	Year.	Quantity.	Official Value.
		lbs.	£.
	1846	52,416	694
	1856	83,808	2,075
	1860	136,192	3,371

From the port of Aracati there was also shipped in 1858, 1,124,320 lbs., valued at £38,055. From special information it appears that the minimum exports from these two ports in 1862 was 1,440,000 lbs., and the quantity consumed in the province of Ceara being estimated at 1,120,000 lbs., it follows that the total quantity of carnauba obtained in 1862 was over 2,560,000 lbs., of the official value of nearly £100,000. The value of this wax exported now exceeds £162,500 annually. I may observe that of all the provinces of Brazil where the carnauba palm grows, that of Ceara alone gives any attention to the collection, and even there only the districts of Aracati and Ceara make of it an important industry. I cannot but think the official statistics given above are far below the reality, for the province of Ceara has more than half a million inhabitants, and these employ carnauba wax alone for lighting. There is also a very active commerce carried on with the adjoining provinces in carnauba candles, transactions which do not come under the control of the customs; and, as the churches are exclusively lighted with them, these facts should be taken into account in the consumption. The commerce in this wax has increased considerably since 1862; in 1863 the official entries of exports through the custom-house of Ceara and its outport, Aracati, were upwards of 2,000,000 lbs. of this wax. Supposing the local consumption to have increased in the same proportion, this brings up the production of carnauba wax to over 4,000,000 lbs. Taking these figures for basis, we may try to discover the number of trees required to furnish that quantity of wax. The harvest of leaves is made during six consecutive months by cutting twice a month, making thus twelve cuttings in the year. Each tree gives on the average eight leaves at each cutting, which forms an annual yield of ninety-six leaves per tree. From an interesting notice by M. C. F. de Lima, a distinguished agriculturist of Ceara, I learn that 500 leaves on good land yield 32 lbs. of wax, but it takes 1200 leaves on poor land to yield the same quantity. Taking the mean of these two quantities of leaves, we find that it requires 850 leaves to obtain 16 kilogrammes, or 32 lbs., of wax. As each tree furnishes on the average ninety-six leaves a year, to ascertain the annual product of each tree, I take the following proportions (calculating in kilogrammes of 2 lbs.): $850 : 16 :: 96 : x$. The result for ninety-six leaves, or for one tree, is 1.807 kilogramme. To ascertain the number of palms necessary for the production of 2,000,000 kilogrammes (or

4,000,000 lbs.) of wax, the yield of 1863, it suffices to establish the following proportion: 1 kilo. 807 : 1 :: 2,000,000 : x . We find the result to be 1,106,799 trees. This number scarcely represents one-fifth part of the carnauba palms distributed over the various provinces of Brazil. This palm thus produces an annual revenue of about 1s. 6d. per tree, which is the more important, as the tree requires no outlay for culture, and suffers nothing from drought, heavy rains or fires. The vegetable wax, which covers in a light powder the leaves of the carnauba, is scattered through the atmosphere, borne by the winds, when it is not collected by the hand of man.

In Ceara, where the collection of the wax is carried on, they have commenced to appreciate its value, and to look to its future importance. A law of the province specially protects the carnauba, by imposing a fine of 2s. 6d. on any one who destroys a tree without the permission of the proprietor. In the province of Rio Janeiro they have commenced planting the carnauba palm, which has succeeded well. This is a useful attempt, because, besides its commercial yield, it contributes to render wholesome the locality where it grows. The collection of the wax is a very simple affair. When the leaves, comprising the network which crowns the head of the palm, separate in the form of a fan, they are cut, taking care to leave the sheath in the centre, which forms the network of the new shoot. To effect this, a sickle or gardener's knife is attached to a long handle of bamboo. A native, well up to his work, can with this cut thousands of leaves in a day. As the cutting continues for six months, one would suppose that the tree would soon be deprived of its fans, but this is not the case, for the vegetation is so rapid that the young shoots follow immediately the removal of the leaves, and the rest of six months given to the carnauba is sufficient to repair the damage from the pruning to which it has been submitted. The leaves are dried on the spot, extended in rows, the exterior on the ground, so that the wax may not escape by the opening of the angles of the fan. In about four days they are collected or heaped up, and a cloth sufficiently large is spread on the ground, around which two or three females place themselves, and taking the leaves beat them with a stick, so that the powder which is to become the vegetable wax falls on the cloth. In order that the powder may be more easily detached, a man splits the leaves into strips by means of a stiletto. To obtain the wax this powder is immediately melted in clay or iron pots, a few drops of water being added. The melted wax is run into moulds of earth, by which it is transformed into cakes of about 4 lbs.; these on cooling, however, break into small pieces, owing to the brittle property of the wax. After the removal of their coating, the leaves are burnt, in default of any other convenient means of utilizing them; but, independent of the wax which they furnish, the leaves might be applied to economic purposes. From time immemorial the aborigines of Ceara have prepared from the leaves a fibre which they twist into twine more or less fine, it is used for a number of purposes, such as for

hammocks, cordage, fishing lines, &c. This industry has made much progress since the conquest of Brazil by the Portuguese, but it still remains in the hands of the semi-civilized natives. The leaves are reduced into fibre, without any previous maceration, by first cutting them into strips, and then passing them over a rough card, consisting of points of iron fixed into a piece of wood. The aborigines made theirs of the teeth or bones of fish. The fibre is in such general use in the province that it must be considerable. The inhabitants, with but rare exceptions, sleep in hammocks, and the cords by which these are attached to posts or trees are usually made of carnauba fibre. It would be possible to form an approximate estimate of the yards of cord employed for this purpose if it were all made of this fibre. However, I may, without much error, take the consumption of cords employed for this purpose at one million. If we calculate them at six yards, we arrive at an annual consumption of six millions of yards, supposing that the cords last but one year. Besides this special use, the cordage is employed for a great number of other uses—for securing the loads which are carried on the backs of beasts of burden; for lashing the bales of agricultural produce for export; for dragging in imported merchandise; for halters and ties for animals; for nets, and a variety of other purposes. We may certainly set down carnauba cordage at one-third of the whole used in the province. The ropes of this palm fibre, strong and handsome, have not yet entered into foreign commerce. The young leaves have also another and very general use in the province and in many of the seaports of Brazil. A great number of articles are made of straw in Europe for which the fibre of this palm is usually substituted in Brazil. Thus, they make of it, and sell at very moderate prices, hats, mats, baskets, brooms, mattresses, &c. These are all in frequent and common use, and are carried by sea along the coast, as well as the leaves for making them. Thus, in the year 1857 there were shipped from the ports of Ceara and Aracati 30,625 mats, and about half a million leaves of carnauba, officially valued at £1500. Another frequent use for these leaves is to make a kind of cushion for the back of beasts of burden to prevent the load injuring the animal. The dry leaves are also employed for thatching cottages. In Ceara and the adjoining provinces one-third of the houses are covered with these leaves, which are remarkable for their lightness, elegance, and durability, and form an impermeable thatch.

As evidence of the wasteful destruction of the leaves by burning, the following estimate may be given. A dry leaf, with the pedicle removed, weighs 134 grammes. The wax powder removed from a leaf is on the average 6.75 grammes. The number of leaves burnt in 1863, calculated on the yield of 2,000,000 kilogrammes, gives 296,444,446. The weight of leaves at 134 grammes each would be 39,723,555 kilogrammes. The immense quantity of textile material thus lost might be easily utilized for cordage, straw, &c. It only involves the cost of collection, which may be set down at less than 2*d.* per cwt. on the spot. The locality

where it could be had in most abundance is the town of Limoeiro, about ten or twelve miles from the port of Aracati, for the carriage-road between the two is bordered by carnauba palms. The British Consul, Mr. Morgan, in 1874, estimated the value of this fibre and its products at £119,500. An attentive examination of the fibre and its abundance suggests its utility as a paper-making substance. The scarcity of rags is becoming greater daily, therefore any raw material that can supply their place is a boon to the paper trade. The pulp of the fruit has a good flavour, and the nut roasted and ground has been used for coffee. From the trunk a fecula, resembling maize meal, is obtained, and also a sap like that of the coconut palm, from which wine and vinegar are obtained. The wood of the carnauba is very useful. Musical instruments are made of it, and channels for water. The roots have the same properties as sarsaparilla.

Not only is it generally employed as a carpentry wood, but it is esteemed for joiners' and cabinet work. It is very hard, of a yellowish red, traversed with black veins, is susceptible of a fine polish, and occasionally offers black shades of a handsome effect. For general carpenters' work not exposed to the inclemency of the seasons, the wood answers admirably, for in such positions it is indestructible. It has nothing to fear from gnawing animals if it is felled at maturity; but if exposed to the weather, its duration is precarious, and it decays in from ten to fifteen years. To make amends for this, it is most durable in salt water, and is much esteemed for piles, palisades, &c., from its great resistance. There have been removed from old marine constructions, abandoned more than a century, piles of this wood in a thorough state of preservation. The carnauba would also be suitable for yards of vessels, as it is perfectly cylindrical, of an equal thickness throughout its length, and very elastic. M. Manoel Dias, of Aracati, thus speaks of the carnauba in the Catalogue of Products shown at the National Exhibition, Rio Janeiro, in 1861: "This wonderful palm is the tree of special utility. Man can with this plant alone construct his house, furnish, and light it; he can obtain from it wherewithal to nourish, clothe, and heal him; he can extract from it fecula, sugar, and spirit. Moreover, it furnishes good food for cattle and the denizens of the poultry yard. No other plant has been supplied by Nature with so many useful properties as the carnauba, which is in the vegetable kingdom what iron is in the mineral kingdom. The products of this palm can be applied to more than forty diverse uses, and it may be added that the number of its various applications is by no means exhausted."

THE BETELNUT PALM.—This palm, the *Areca Catechu*, is generally admitted to be the most graceful and elegant of the Eastern palms. It is extensively distributed over India, but is cultivated chiefly on the Malabar coast, in the north of Bengal, and the lower slopes of the mountains of Nepal, the south-west coast of Ceylon, Siam, Cochin China, Pinang, and Sumatra. Unlike the coco palm, it will thrive in high regions and at a distance from the sea

From Ceylon the export seems to be on the increase, for, whilst in former years 60,000 to 70,000 cwts. was the average, the shipments now reach occasionally 160,000 cwts., besides a large home consumption. The value of the shipments range from £60,000 to £100,000.

This palm begins to bear fruit after five years, and continues productive for twenty-five years. It flowers in April and May, and the nuts are ripe in October. There are about 50,000 acres under culture with this palm in Ceylon.

An extensive commerce is carried on in the East in the fruit of this palm, which forms a main ingredient in the Eastern masticatory. Blume tell us that the Asiatic nations would rather forego meat and drink than their favourite betelnuts, whole shiploads of which are annually exported from different quarters. One hundred millions of people use the betelnut. There are said to be twenty different species of *Areca*, but probably many of these are only varieties. This palm often grows 50 feet high, with a diameter of less than two feet; it has no branches. The fruit, a drupe, about the size of a pullet's egg, does not fall from the tree even when ripe; it has a yellowish shell, thin, with arched veins, cohering with the pulp all round.

It is stated that a fruitful palm will produce on an average 850 nuts annually, but the mean may be taken at 300 nuts. The average production in a plantation is about 10,000 lbs. of nuts per acre.

A cargo of betelnuts generates so much heat that the crew cannot sleep between decks. In the Cossyah or Khasia country the natives measure distances by the number of mouths of betelnuts chewed on the road.

In the island of Yap, Western Pacific, the betelnut tree is cultivated with the greatest care. It is a beautiful slender palm, and grows amongst the coconut trees, which it resembles in appearance. The nuts are pulled before they are ripe, and are chewed with the usual condiments, lime and aromatic leaves, by both sexes. They are called *Addāca* in Travancore. In the Bombay market three kinds are met with: white, from Shevurdhun, which are three times the value of those from other countries; red, which are half the value of the best white; and nuts in the husk, sold by the thousand. The crushed nut is generally used with the leaf of the betel-pepper (*Piper Betle*) and chunam or shell-lime. Prepared slices of boiled betelnut, called *Cally-areka*, are sold in Cochin at about 6d. a pound.

The mastication of the betel is considered very wholesome by those who are in the habit of using it. Mr. Crawford thinks that, like tea, coffee, and tobacco, the areca nut stimulates the nervous system, and hence its general use. It may be so, but the dark hue it imparts to the teeth (although it is said to be an excellent preserver of them), together with the blackened lips and mouth, give anything but an agreeable appearance.

Betelnuts contain a large quantity of tannin, which has caused them to be employed in some parts of India for dyeing cotton cloths.

The exact country of the betelnut is unknown, but is supposed to be the Sunda Islands; the tree, from time immemorial, has been extensively cultivated in all parts of the East Indies, so that we are unable to trace it back to the spot whence it originally may be supposed to have come. It grows freely in all the eastern islands, from Sumatra to the Philippines, and seems to have as many distinct names as there are languages. Thus in Malay and Chinese it is called *Pin-lang* or *Pinang* (giving its name to the island in the Straits); in Sumatra, *Jambi*; in Bali, *Banda*; in Bugis, *Rapo*; and in Tagala and Bisaya, *Bongo*; in Achin, *Penu*; in Sanscrit, *Goorvaka*; in Bengalee, *Gooa*; in Arabic, *Fofal*; in Persian and Hindustani, *Soopara*; and in Telugu, *Poka Chettu*. Judging by this, the probability is that the tree is indigenous in each country. In the fresh or green state, the betelnut is an object of general domestic consumption; and in the dry state, of large exportation to China and India. The most productive countries in this article are Ceylon, and the northern and southern coasts of Sumatra, towards its western extremity. At Billiton, in the Eastern Archipelago, there were in 1874 65,223 Areca palms.

At Travancore, where the betelnut is a staple product, a quarter of a century ago, there were ten and a quarter million trees growing, which, at the average yield, would produce about 63,000 tons of nuts. In the Indian trade returns betelnuts are included among spices. The following shows the imports into India, which come principally from Ceylon, the Straits Settlements, and Sumatra. The average imports in the five years ending 1887 were 15,000 tons. About 2 to 3 million nuts are received from Sumatra, about 16 millions from Ceylon, and in 1886 nearly 28 million nuts from the Straits Settlements. In Pinang there are half a million, or more, betel palms, producing upwards of 3000 tons. The Pedir coast of Sumatra produces annually about 4700 tons, of which half is exported. The Chinese receive from thence 3000 tons, besides as much from Cochin China. In Cochin China there are about 80,000 acres planted with this palm. It takes eight years before it fruits, and the aggregate bunch of nuts sells for 6*d.* to 8*d.* When there is not an immediate demand for the nuts they are stored in the husk, but insects attack them freely. Of the nuts produced in Travancore, 300 tons of prepared nuts are annually sent to Tinnevely and other parts of the peninsula, and about 3,000,000 ripe nuts, in the husk, to Bombay and other places by sea. The local modes of preparing the nut for use in Travancore are as follows:—Those used by families of rank are collected while the fruit is tender, and the husk, or outer pod, is removed; the kernel, a round fleshy mass, is boiled in water. In the first boiling of the nut, when properly done, the water becomes red, thick, and starch-like, and, this is afterwards evaporated into a substance like gambier or catechu. The boiled nuts being now removed; sliced, and dried, the catechu-like substance is rubbed on them, and when dried again in the sun they become a shining black colour, and are ready for use. Whole nuts without being sliced are also prepared in the same way for use. Ripe nuts, as

well as young nuts in the raw state, are used by all classes of people, and ripe nuts which have been steeped or kept in water are also used by the higher classes.

The nut is conical, but varies, some having an elevated apex and small base, others a large base and a very slightly elevated apex. The nuts are gathered in July and August, though not fully ripe till October. The quality of the nuts does not at all depend upon their size, but upon their natural appearance when cut, indicating the quantity of astringent matter contained in them. If the white or medullary portion which intersects the red or astringent part be small, has assumed a bluish tinge, and the astringent part itself be red, the nut is considered of good quality; but when the medullary portion is in larger quantity, the nut is considered more mature, does not possess so much astringency, and is therefore not so much esteemed.

The areca nut fibre is worthy of notice because of its capability of being turned to many useful purposes, especially as it has a soft and cotton-like feel, and is capable of being spun into twine. Moreover, immense quantities of the husks are now thrown away. and should this fibre be found capable of being made into paper, or turned to other useful purposes, of which no doubt is entertained, it may be collected in large quantities, and at little cost.

The Nagar division of Mysore, in consequence of its hill tracts and moist climate, offers peculiar facilities for the cultivation of this palm. So we find almost every hut sheltered by a shady grove of these trees, whose slender forms sway with the breeze, and whose fringing tops, whilst murmuring amid the mountain solitude, cast a fragrance around from their aromatic blossoms.

The land most congenial to its growth seems to be a level out on the slope of a hill, or some sheltered valley rich in vegetable deposit. That it is a tree requiring manuring like the plantain is obvious, from the trees needing trenching and manuring round annually to ensure a good crop of nuts.

The ripe nuts are gathered, and, after being peeled on a sharp knife fixed on a board, are cut in two, and dried in the sun. Another process is slicing the nut and parboiling it.

The Mysore nut is considered superior to all others, and forms four-fifths of the consumption in Madras. The nut imported from Ceylon and the western coast is not so much appreciated, and commands a much lower price in the market.

The land devoted to the areca and coconut palms in Mysore amounts to 48,000 acres, of which the bulk (43,000 acres) is under areca trees.

In the northern coasts of Acheen, especially Pedir, much attention is given to the Areca palm, and large quantities of betelnuts are sent to Penang and the Coromandel coast.

At Pedir, Acheen, and other parts of the East, betelnuts are sold by the *loxa*, or *laxar*, which weighs about 168 lbs., and consists of 10,000 nuts, with from 10 to 25 per cent. added, according to the bargain previously made, to make up for nuts which may be worm-eaten or otherwise damaged.

The following table gives the exports of Areca nuts from Ceylon in the years named:—

Year.	Quantity.	Value.
	Cwts.	£.
1850	66,254	42,907
1860	75,996	56,997
1870	76,558	65,501
1880	158,167	125,449
1886	139,492	107,390

In Europe there is little demand for betelnuts. Small quantities are occasionally received. They are grated and given to horses as a preventive of diarrhoea, and burnt into charcoal for tooth-powder, and sometimes they are turned into small fancy articles, such as rosaries, bracelets, etc.

The leaf of the BETEL PEPPER (*Piper Betle*, Lin.; *Chavica Betle*, Miq.) is inseparable from the use of the betelnut, the slices of which are wrapped in a leaf of that plant, over which a small quantity of chunam or lime is spread, to which a fine pink colour is given by mixing a little turmeric, and flavoured with spices, which constitutes the preparation known as pan. This is chewed by the natives of India as a mild stimulant, especially after meals.

The shrub is cultivated all over India in most districts. In 1870 there were 16,000 acres covered with it in Madras. It is planted in rows, requires a moist situation and a rather rich soil.

The plant has been found wild in Java, which is probably its native country, and is extensively cultivated in the Malay countries. In Bengal it is grown within a fenced enclosure, covered on all sides and on the top by reeds. Its use is considered in the East to be conducive to health. It acts as a powerful stimulant to the salivatory glands and digestive organs, and has been found to be an excellent preservative against scurvy in long sea voyages.

The betel pepper is cultivated at Zanzibar, where the use of the betelnut prevails, as it does in the Comoro Islands and at Bombay; but the custom is not in vogue in Arabia. The betel palm is also grown on the Island of Zanzibar.

The DATE PALM (*Phoenix dactylifera*, Lin.) flourishes in all the vast regions of the tropic of Cancer, from the Atlantic Ocean to the valley of the Indus, between 12° and 57° N. lat. Throughout this immense space, it is, with the bamboo in Eastern Asia and the coconut in the equatorial regions, the most precious gift of Nature to man, for it contributes to all his most essential wants, food, clothing, lodging, cooking utensils, &c.

The date is the special tree of the Saharan regions. Its constitution, temperament, and habits particularly suit it to the African climate, which is especially characterized by the deficiency of rain and the digressions of temperature. Its fruit is the source of sustenance for the nomad or sedentary people scattered over its

immense countries. It is the most common tree in all the valley of the Nile, and is found in greatly increasing numbers from the village of Ibrim in Lower Nubia to the Mediterranean. The dates of Upper Egypt and the Oasis are the most delicate. They are not left to ripen on the tree. After being gathered and exposed several days to the sun they get ripe, and are then a very fine and sweet fruit. The date palm has from two or six to twelve or fourteen spadices. When these are too numerous, it becomes requisite to remove some in order that the tree may not be weakened or thrown down by the weight of the bunches, and the fruit being too numerous would not be of such good quality. Four hundredweights of dates have been gathered from one tree in Egypt.

Although the countries where the date flourishes best are characterized by an absence of rain, it will not fruit without its roots are well watered. Hence there is a native proverb that the date must have its head in the fire and its roots in water, proving the necessity of frequent irrigation.

The date palm, cultivated and attended to from time immemorial, has produced in the hands of the natives as many varieties as our most carefully cultivated fruit trees. Dr. Edward Vogel, who paid considerable attention to this subject, writing from Murzuk, in Feddan, gives a list of thirty-seven kinds, with full descriptions and figures, in 'Bonplandia,' vol. ii. p. 74. The largest (and what appears to be the best) is $21\frac{1}{2}$ lines long and 10 in diameter; the smallest $7\frac{1}{2}$ by 5. The different dates are of almost every colour except pure white and black. There are not, as is the case with our apples and pears, early and late sorts, but all arrive at maturity pretty much about the same period (restricted to within a fortnight), which falls in Fezzan about the latter part of August, in other parts one or more months later. Besides those destined for home consumption in the country, dates of a superior quality are gathered, and, after being prepared with great care, fetch a good price in the markets of Europe. Several Parisian merchants within the last few years have given importance to this trade, by proceeding each year to the seat of production in Algeria, and preparing on the spot, by special modes, large quantities of dates for France, which replace with advantage those formerly procured from Tunis and Egypt. The region of Ziban, to the south of the province of Constantine, is the part of Algeria where the culture of the date occupies the largest surface, is carried on with the greatest care, and where the fruit is of the best quality. This region includes nineteen oases, of which Biskra is the principal. Laghouat, in the province of Alger, is another centre of production.

The principal production of Touggort, Soub, and the oasis in French territory is the date, and there are about 124,300 palms subject to taxation, but the total number is nearly double that. Each tree yields about 4s. return yearly to its owner. Estimating the average yield per tree at 100 lbs., there would be a total product of 62,150 cwts. per annum. There are two qualities of dates produced, the *Deglet nour*, the best, which sells at 30 francs the cwt., and the *Ghars*, or ordinary, at 20 francs.

In Goleah, in the Great Desert, there are about 16,000 date palms, of which 14,000 are in full bearing.

The best trees are those produced from slipped plants. Those raised from seeds are much longer in arriving at maturity, and are generally poor. When the slip, taken from the foot of the stem of an adult tree, is first planted, it must be watered daily for six weeks, and every other day for the next six weeks; after which the trees are watered once a week in summer, and every month in winter.

The nut does not commence to germinate under six months or a year after planting, and the growth is very slow in the first two years. In a favourable situation it will begin to fruit at six years, and lasts to seventy years or more.

The tree commences to yield fruit about five or six years after planting; but it is not till after twenty or twenty-five years that it comes into full bearing, and then it will endure for about one hundred and fifty years. A date tree in full bearing will produce eight or ten bunches, each containing 12 to 20 lbs. of fruit, which, at an average of 144 lbs. of dates per tree, is at the rate of 14,400 lbs. per hectare ($2\frac{1}{2}$ acres).*

In the oases of South Algeria 130 varieties of dates are enumerated, each with a distinct name; in Egypt they have about 50 varieties, and in the Persian Gulf over 100. Although there are so many varieties of the date differing in size, form, and quality of the fruit, they may chiefly be divided by colour into three classes, red, yellow, and whitish.

The dates, after having been gathered, are dried in the sun, and, when quite hard, sometimes buried in the sand. They may thus be preserved about two years; but generally after eighteen months they are attacked by worms, and in the beginning of the third year nothing remains of them save the stones. As an every-day food, dates are considered very heating, in consequence of which they are not much used on journeys, as causing great thirst. The most relishing and wholesome way to eat them is when made into a paste mixed with barley. Each year the lowest ring of leaves falls off, so that the age of a palm may be roughly calculated by the notches on the stem. It will bear for at least two hundred years, but after a century, its fruit begins to decline, and it is generally then cut down for building purposes. Each proprietor has a right to two hours' water in the day from the stream which passes by his grounds, and this right is always specified in the title-deed by which he holds his garden. Before the dates are ripe, each family is bound to set apart one tree, all the fruit of which is consecrated to the service of the Mosque and the use of the poor. From the juice of the tree is made a fermented wine or liquor called *lagmi*, of which the Arabs are very fond. In its fresh state it has an insipid taste like new beer. It is produced in Egypt by simply making an incision in the top of the tree, reaching the centre. A tube is fitted, through which the sap flows into a bamboo-joint vessel. The palm thus yields about ten quarts every

* Hardy, "On the Culture of the Date in Algeria," 'Bulletin of the Society of Acclimatisation,' Paris, vol. v. p. 63.

morning. The Egyptians bleed the tree every two months, sometimes every day, to prevent the healing of the wound. The operation will kill the tree if continued too long, but cautiously practised for a few days, will often invigorate a sickly or ill-bearing palm. The cabbage, or heart of the date tree, is also eaten, and the taste approaches that of a sweet potato, but it is never cut unless the tree has accidentally fallen.

The bunches of fruit are suspended by peduncles as thick as a man's fist. The yellow dates are the smallest, and the black generally the largest, but there is a larger variety of the yellow date. The fruit does not all ripen at once, but each date matures separately, and, falling, makes way for another to ripen.

Some of the dates are palatable even in their unripe state, red or yellow known in Persia as *khárák*. In this state the date is crisp, like an apple. At first it is astringent, and then it becomes sweetish. In this stage it is largely eaten in the Persian Gulf. Certain varieties of dates do not ripen beyond the "*khárák*" stage, and can only be preserved by boiling and drying in the sun, when they can be kept for a year without spoiling, while others ripen to the soft and completely sweet stage, called "*khoorma*," in Persia. The fresh "*khoorma*" will not keep anywhere more than two or three days, if kept in a heap, as it turns sour and spoils. It requires to be further cured by drying in the sun. There appears to be no such thing as a whole bunch of dates ripening all at the same time. As the individual dates ripen they are either shaken down or picked off. Certain varieties, however, can be left on the tree till the whole bunch is ripe, and sufficiently dry (like raisins) to be packed and exported without further preparation.

In this dried state they form the principal food of the Arabs, and are esteemed by many other nations. The crushed dates, which arrive in Europe in mass, are the inferior and damaged sorts.

At the time of the collection of the ripe fruit, receptacles, walled with masonry, sometimes in the form of large oil jars, are prepared in the yards of the houses to hold the dates; these will contain from 2000 lbs. to 6000 lbs. Men tread the dates down, adding from time to time a little water to soften them. An opening is left at the bottom to allow the syrupy fluid to be collected. This is eaten with butter. In the winter this mass of date paste or cake, is commenced upon, and it is so solid that an antelope horn, or some other hard tool, has to be used to dig it out.

The date palm is found growing in Central Africa, according to Dr. Baikie, as far south as Lukoja.

Its various useful products are very numerous. The petiole, or leaf-stalk, is employed for fences, and other supports. The tow from the leaves is spun, used for stuffing saddles, and serves as tinder. The fibre it yields is of use as a textile material; of it are made ropes for wells and cordage for vessels, as it is not impaired by sea water. The fibre is obtained from the terminal shoot of the tree, and also from the leaves. The peduncle which bears the fruit yields a very strong thread, of a silvery white, resembling that of the agave, which is used in the baths as a friction rubber. From

the split leaves of the palm, or with its follicles, mats and baskets are made, as well as chairs or seats, at a very low price. The trunk is employed as posts by carpenters; the wood is compact, and easily cut into thin planks, which take a fine polish. It may, indeed, be called the pine wood of the desert, for it is the only long and straight timber to be met with in the regions where it flourishes. From the unripe fruit, spirit and vinegar, and syrup or molasses, can be made. The crushed kernels or seeds of the fruit are given as food to domestic animals, being greedily eaten by camels, goats, sheep, horses, and dogs.

In Egypt there are 4,000,000 female date palms grown, and the annual production of dates there is estimated at 15,000,000 cwts. annually, but they are nearly all locally consumed; only from 300 to 700 tons being exported yearly from Alexandria. Those best known are a stoneless kind, the dates of Assouan, Siout, Edfou, of the oasis near Esneh, Helwa, Minieh, and Menchiek. The dates of Upper Egypt and the oasis are the most delicate.

The fine yellow dates of Rosetta and Burlos are preserved, and much sought after in Europe, and might become the object of an important commerce. In preserving them the epidermis is removed, and the two ends cut off; the stone is taken out by means of a small piece of wood, and the fruit thus prepared is boiled in water to soften and separate an astringent principle; they are then placed in a bucket to drain, after which they are put in a glazed pot. There is then added some hot concentrated sugar, in which they are left for six hours. At the end of that time the syrup, having lost its consistency by reason of its mixture with the water contained in the dates, is put on the fire and concentrated as before. Some more dates are then added, in which parched almonds have been placed, or some pistachios instead of the stones, in order to keep them from getting out of shape. It is then boiled again, until the syrup becomes more solid, and afterwards put into earthenware pots. When cool a little pulverised sugar, impregnated with essence of lemon, is added to flavour it.

The principal revenue in Tunis is derived from their excellent dates, which are exported in large quantities. According to an enumeration made some twelve years ago, there were 1,000,000 date trees in the Djereed, one of the most important provinces of the Regency, which are taxed by the Government. As the young trees are not included, and there are grounds for believing the calculations to be incorrect, it is presumed that the total number exceeds 2,000,000, which produce 300,000 cwts. of dates, valued in the locality at £487,000.

In a recent work on 'Tunis; the Land and its People,' by Chev de Hesse-Wartegg, we find the following:—"The Oasis of Southern Tunis—on both sides of the large salt marsh, Sebcha Pharaon, which latter reaches far into Algiers—is a beautiful country of palms, which is not surpassed by anything on the shores of the Nile. . . . This palm region *par excellence* is known in Africa, under the name of 'Beled-el-Djereed,' and no fruit is valued higher than the sweet, large, and juicy Djereed date, which also fetches

the highest prices in European markets. . . . Gaffa is the largest oasis in the Djereed district. It possesses a palm forest of about 200,000 trees, and is inhabited by from 3000 to 4000 Arabs and Berbers. The number of palms in the 'Beled-el-Djereed' is enormous. The oasis of Neifzani, south of the salt marsh, contains not fewer than 300,000 trees; that of Gaffa, 200,000; in 'El Gettar' a palm forest extends over a track of land three kilometres long, and the entire region north of the 'Sebcha Pharaon' possesses no less than 1,500,000 palm trees, with as many olive, orange, and almond trees growing between! . . . South of the great Shott is the extensive district of the oasis of Neifzani, with palm forests of more than 300,000 trees, and with from 18,000 to 20,000 inhabitants, living in forty villages."

The ordinary kind of dates are made into a paste or cake, which forms the staple food of the Bedouin Arabs in the Sahara. It is highly nutritious. The dates are sometimes eaten fried in butter, or simply with fresh butter uncooked. In former times the chief market for dates was Touzer, to which the merchants from Ethiopia resorted with slaves, whom they exchanged for a very few hundredweights of dates, but this traffic has now ceased. From Morocco about 4000 cwts. are sent to the London market.

Bagdad sends away 3000 to 4000 tons of dates yearly. The date groves of Bussorah are of great extent and value, forming an almost unbroken line of from one to three miles in depth along both banks of the Euphrates and Shat-el-Arab, from Medinhab to the sea—that is, for more than 140 miles—and yield annually from 40,000 to 60,000 tons of dates in a good season. In ordinary years about 33,000 tons are produced in the Turkish portion of this district, and 26,000 tons in that under Montefik rule. About half the above may be roughly stated as consumed in Bussorah and in the interior, and the other half exported to the Persian Gulf ports, India, and England.

An average of five years—1879 to 1883—gives the following annual trade in dates in the Persian Gulf:—From Bushire to England, India, Java, Aden, and the Red Sea, about £3,800. From Muscat to India, Yemen, Zanzibar, and America, about 769,800 dollars. From Soor, Kharyyat, and Batuah, to other places not named, about 1,539,000 dollars.

The kinds most esteemed are hallowee, zehedi, and khudtherawee; the other varieties, of which there are no less than thirty-six, are known in commerce by the common name of sayr.

The import of dates into India from Arabia, Persia, and Turkey in Asia, were as follows:—

Year.	Quantity.	Value.
	cwts.	£.
1881-82	650,106	312,209
1882-83	687,845	231,872
1883-84	559,475	243,028
1884-85	610,781	280,855
1885-86	621,739	287,102

The smaller imports in 1883-84 was the result of poor crops in the palm groves of Asiatic Turkey.

The dried dates are pulverised, and this meal is carried with them by the Arabs on the journeys. By allowing the dates to ferment in water, a vinous beverage is obtained, which is also much esteemed. When the fruit has been left to ripen thoroughly on the tree, and has attained a fine red colour, it is too soft to be dried, and hence is made by pressure into a solid cake or mass called "adjoue," and with us "date-cake." A great quantity of this is sent from Bussorah to India. These bales of date-cake are sold in Cairo during the winter. In travelling, dates soaked in water form a mild and refreshing drink.

An analysis of dates gives :—

	Per cent.
Fine sugar	78·80
Gum	2·50
Cellulose	15·50
Fat	0·20
Other substances	3·00
	100·00

The consumption of dates is not large in the United Kingdom, but of late years we have no official returns, as the Board of Trade does not consider dates and various other minor fruits worthy of record. In 1860 only 11,300 cwts. were received, but in 1870, 93,873 cwts. came in, value £70,611. Our import of dates from Turkey are now about £150,000 to £200,000 in value.

The SPINY DATE (*Phoenix spinosus*, Thonning) is met with in the delta of Nun and Brass, West Africa, and in some parts of Central Africa, generally with the oil palms. The leaves are extensively employed in Núpe and Yúriya for making fine mats. This palm extends from tropical Africa to the Cape Colony, where it is indigenous. Dr. Kirk found the green bunches, if immersed in water for half a day, suddenly to assume a scarlet hue, and then the astringent pulp to become edible and sweet.

The WINE or BAMBOO PALM (*Raphia vinifera*, Beauv.; *Sagus vinifera*, Poiret; *Metroxylon vinifera*, Spr.).—This West African palm is constant along mouths and in deltas of rivers; also, according to Dr. Baikie, inland, in moist places in Ibo, Benín, Yoruba, Dahomi, &c.; and still farther from the sea in Korórofa, Adamawa, Bautsi, Yúriya, Gbári, Núpe, Kambari (as far as near to Yaúri), Bórgú, Gurma, and along the road to Gonja. The greatest known distance from the sea is the town of Kuno, more than 400 miles from the sea.

The dried pinnæ of the leaves are used for making ropes, pretty bags, and mats, dyed hats, and for tying thatch; the long midrib of the leaves, often upwards of 30 feet in length, in construction of roofs of houses, for poling canoes, for making seats, couches, &c.; the soft inside part for making a large kind of mat used in

travelling, and called by Hánsa and Núpe "Memme"; the sap used as a kind of palm wine, termed Bourdon, and much relished by the drunken savages of the coast. Fruit occasionally eaten (the mesocarp), but bitter, and in a few places, as in Kúpa, oil is made from it. The fibre of the midrib is also woven with cotton into a kind of cloth in Benín and Yóruba.

The DOUM PALM of Upper Egypt (*Hyphene Thebaica*, Mart.; *H. crinita*, Gaert.), grows away from the sea. The fruit of this is much larger than that of the date palm, and is equally nutritious. The pulp of the fruit is brown and mealy, and has both the taste and colour of gingerbread; hence one of its common names is the gingerbread tree. The spongy, internal portion of the fruit of this palm forms an important article of food, and when mixed with an infusion of dates, it constitutes a cooling drink, much prescribed by the Arabs in febrile affections as cooling and demulcent.

The kernel is turned into beads for rosaries, and little perfume cakes are made of it at Kuno. The leaves are used for mats and the best kinds of hats in parts of Central Africa. Dr. Baikie states that the most southern station for it is Lukoja.

The DWARF PALM (*Chamærops humilis*) is widely spread over the Algerian Tell, and particularly the departments of Alger and Oran. Its presence is a sure indication of good soil, in consequence of the depths of its roots, which form, at 3 feet or more below the surface, an inextricable mass, the removal of which renders the clearance of these palms from the soil for cultivation a serious and expensive affair. The dry portion of the alluvial plain of the littoral is that where they most abound, for they would perish in a wet or swampy ground.

Northern Africa generally is covered and infested with this shrub, which multiplies rapidly, and was long the pest and grievance of the colonists, who were obliged to grub it up. But now it has become a useful aid to industry, and, instead of being considered a barren and worthless plant, it has become a source of profit and commerce. Properly prepared, the leaves furnish a fibre which, dyed black, twisted, and curled, furnishes a vegetable hair, that can be employed like horsehair, as a stuffing material in upholstery, or in matting. It possesses two advantages over the animal fibre which have led to its extensive employment, viz. those of being exempt from insect destruction, and 75 per cent. cheaper than horsehair. The leaves are now sold on the spot for about two to two and a half francs the cwt., and a man can cut say 400 lbs. a day. It is generally the Arabs and Spaniards who apply themselves to this work. The first idea of using the leaves of this indigenous plant of Algeria, as a substitute for horsehair in upholstery, is due to a M. Averseng, who took out a patent for it in 1847. This manufacturer had great difficulty at first in carrying it into execution, but the necessity for cheap articles, which increases daily, greatly aided him, and established the reputation of this substance. If it has not all the good qualities of horsehair,

it does not want for suppleness and elasticity, and, mixed with it, greatly reduces the cost of stuffing in beds and furniture. The form in which the raw material is bought for working is after the leaves have been combed or stripped. This is a very simple operation, which requires but cheap tools, and can be carried on by women and children. A good operator on the handful of leaves can prepare 90 lbs. to 100 lbs. of dry fibre, which, at the current price of 12 francs the cwt., gives a return of $5\frac{1}{2}$ to 6 francs per day, with the mere aid of a child, eight or ten years old, to cut off the leaf-stalks and gather the leaves into handfuls. Many native families find their means of existence in this occupation. The men cut and gather the leaves, and the women and children comb and prepare them into fibre. This is a new example of union of the two races in labour, and a hopeful instance of their permanent fusion in the future. The combing or preparing the palm leaves is also a great resource for the French colonists in the period of rest between the harvest and the first labours of autumn. The fibrous thread, when dry, is handed over to the manufacturer. The hair, called "crin vegetal," light or green, is twisted and curled in its raw state, and packed. For black the fibre is first dyed, by being passed successively through baths of sulphate of iron and logwood. It is then twisted, and the cord again dyed. The firm of Averseng, of Alger, at their works El Affroun, prepare annually 3,500,000 kilogrammes of dry fibre, representing about double that quantity of palm leaves, the average yield of fibre being about 50 per cent. In the department of Oran, Messrs. Giraud Brothers, in their large enclosed works at Eckmuhl, covering a space of 5 acres, prepare daily 60 bales of 2 cwt. each. The combing is effected by means of drums with needles and knives, worked by a 12-horse power steam engine, at a speed of 300 revolutions per minute.

They also heat their dye vats by steam, which is much more economical than the application of direct heat. Another Algerian firm, J. and J. Mathieu, whose factory is at Arbra du Dgendel, in the plains of Cheliff, by a particular process, prepare a black and brilliant crin vegetal without smell or dust, of which they turn out 1000 cwts. a month at 30 francs the cwt., the undyed being sold at 20 francs. This fibre, like the esparto, is also twisted into ropes and cables. It has long been used as a paper-material in conjunction with esparto and rags. The 'Akbar,' a newspaper of Algiers, is printed on paper of this kind, and quantities have been imported from time to time for use at Lloyd's paper mills in Kent. It is not, however, held in much estimation for paper-making, as there is a good deal of waste from the tough leaf-stalks, and it requires a considerable quantity of chemicals to bleach it. In 1857 the export of leaves of the dwarf palm from Algeria was to the value of 24,000 francs; crin vegetal, 763,000 francs. The shipments of crin vegetal, which were only 19,000 lbs. in 1845, in 1860 amounted to nearly 2,500,000 lbs. In 1865 they had reached treble that amount. 44,000 cwts. of crin vegetal was shipped from Algeria in 1868, and the value of the fibre prepared in that year in the colony is stated to have been about £90,000.

The quantity of this vegetable hair sent to foreign countries in 1872 was 2,394,000 kilogrammes. In 1887 the exports were as much as 15,304,126 kilogrammes, valued at £88,200. The shipments, which were formerly limited to France, are now extending rapidly, demands having sprung up in various countries, especially in England.

The first shipments of rough palm leaves for paper making were made about 1852. In 1871 it reached the largest quantity, 1,171,737 kilogrammes, the exports in 1887 being only 270 kilogrammes.

There is an extensive trade carried on in other palm leaves, such as the Palmetto of the Americans (*Sabal palmetto*, Lodd.), which extends from Florida to North Carolina.

The leaves of the Saw Palmetto (*Sabal serrulata*) of America, are used for cabbage-tree hats, and form a substantial thatch for houses. They are also dried, put up into bales and sold for paper stock. The tough fibrous roots, resembling in texture the husk of the coco-nut, are easily formed into scrubbing brushes. The leaves of *Sabal Mexicana*, Mart., *S. umbraculiferum*, Lodd., the Palmetto Royal of Jamaica, are also used for thatching, for baskets, mats, and cordage, and for sombreros, or large hats, in Mexico and Central America.

S. Adansoni, another American species, has a farinaceous trunk, the pith of which serves for food, and the roots are used in tanning.

Thrinax argentea, furnishes a sinnet, or chip, which is woven into hats, and there is a large import of palm leaves for plaiting, into China, but these scarcely deserve special detailed enumeration; suffice it to say, that there was imported into the port of Shanghai, in 1871, 4,755,117 piculs of untrimmed palm leaves, and 231,091 trimmed palm leaves for making fans.

The *Attalea* genus of palms are nearly all natives of Brazil; one or two species yield the valuable brush fibre known as Piassaba, and a species common to British Honduras (*A. Cohune*, Mart.), was recommended to notice some years ago, from the fact of its nuts yielding a good, useful, white oil.

SECTION III.



THE TROPICAL CEREALS AND STARCH-PRODUCING PLANTS.

INDIAN CORN (*Zea Mays*).

ON every part of the globe where the hand of civilisation has broken the turf, this beautiful grain receives a large share of attention. In the western continent it is raised from Canada to Patagonia and in the islands of the South Seas, through almost every variety of climate and people, and over an extent, from north to south, of more than 7000 miles. It was introduced into Africa by the Portuguese in the sixteenth century, and is cultivated more or less from the Mediterranean Sea and the Libyan Desert to the Cape of Good Hope. In Java and the Asiatic isles it forms an important product. In Central Asia it is known and valued, as well as in Australia and the islands of the Indian Ocean. In Europe it is extensively produced in Hungary, Lombardy, France, and Spain, and we might almost say from the Ural chain to the Atlantic. No grain could secure such favour from all parts of the world except from its intrinsic value. No other cereal, in fact, except rice, is so extensively cultivated.

Its flexibility of organisation makes it very easy of adaptation to climate and soil. Though it prefers moist and rich soils, with strong heats, there are varieties of it which can be raised in tropical climates, at a height of more than 9000 feet above the level of the sea. The warmest regions of the torrid zone produce maize in abundance, where three crops can be taken in a season, while the short summers of Canada have a variety adapted to them. This cannot be said of rice, which requires great heat, and cannot endure a climate of high latitude.

Indian corn ripens at a time when most other grains have been harvested; it therefore furnishes employment, when there would naturally be but little else to do.

No plant is more beautiful, and none so well suited to different varieties of climate; for everywhere between the 43rd degree of north latitude and a corresponding parallel south, it may be grown in the greatest perfection. Its ease of hybridization has produced innumerable varieties, suited to every kind of soil and every degree of temperature, from the time-enduring hard corn of

Canada to the Stowell's evergreen for boiling in the unripe state. It is met with adapted to summers varying from three to six months; thus we find it in the North requiring but half the time for its growth that is requisite in the South, and still in each locality are kinds appropriate to the different lengths of summers.

United States.—We may say of the Indian corn crop of America what Mr. Webster said of the turnip crop of England, that "its failure for three successive years would nearly bankrupt the nation."

It is the food of both man and animals; and even its stalks, by proper treatment, have been rendered equal in value to the whole labour and expense of raising the crop. To it America is indebted for her fine beef, her plentiful supply of pork, and also as an article of human food. It is the plant of the country; and the olive branch might with propriety be taken from the claw of the national emblem, and the Indian corn grass substituted in its place. In proof of the American origin of this plant, it may be stated that it is still found growing in a wild state from the Rocky Mountains to the humid forests of Paraguay, where, instead of having each grain naked, as is always the case after long cultivation, it is completely covered with glumes, or husks. Columbus found the natives of Hispaniola cultivating it in extensive fields, and those of other places visited by him were also in possession of it. The first Englishmen by whom it was cultivated were they who settled in Virginia in 1760.

In England all cereals used as food for man are called "corn," but those who first landed in America from that country found a new cereal, also used as food by the aborigines. They added it to their catalogue of corn with the prefix of Indian. As it had been for ages the main dependence of the Indians, so it has since become the real staff of life to sixty millions, who now occupy their places, while it is gradually making its way to favour among other millions in Europe. Wheat can be profitably cultivated only within certain latitudes, but Indian corn grows luxuriantly in all. The border States of the tropics refuse to yield wheat. Louisiana and Florida produce but 10,000 bushels of wheat annually, but nearly 9,750,000 bushels of corn.

The annual average wheat crop of the world is about 2,000,000,000 bushels, of which nearly 450,000,000 may be credited to the United States. Her Indian corn crop now averages 1,900,000,000 bushels, nearly equalling the wheat crop of the whole earth.

Indian corn is one of the most important and healthful articles of human food that a beneficent Providence has bestowed upon man; and to its high nutritive value is due in a large degree the strength and vigour of the race of men who laid the foundations of the great American Republic. It was much more largely used fifty or one hundred years ago than now, as fine wheat flour, for some not well-founded reason, has much usurped its place in bread-making. In the several forms, however, of hulled corn, popped corn, hominy, samp, corn starch, maizena, &c., vast quantities are consumed by all classes of people in America.

Meal from Indian corn contains more than four times as much oleaginous matter as wheat flour, more starch, and nearly as much nitrogenous material, consequently in all cold climates it is admirably adapted to sustain the system by furnishing heat-forming compounds. The oil gives warmth, the nitrogenous principle gives muscular strength. The combination of alimentary compounds in Indian corn renders it alone the mixed diet capable of sustaining man under the most extraordinary circumstances. It holds the elementary principles which constitute the basis of organic life. In this particular it is more remarkable than any other vegetable production known to man.

Among the indigenous grains of the American Continent, Indian corn (*Zea mays*) thus stands pre-eminently high, as regards its value to the human family as an article of food, as well as for its use in manufactures. There are many species of wild rice, wild oats, wild rye, millets, and other cereals, that go far to sustain life, but none of them can take rank with maize in its now almost numberless varieties. It is this great variety that has caused a doubt with some as to these having originated from anything like a single species.

Doubtless, the mere difference of latitude or length of the growing season, or mode of culture, or quality of the soil, have an influence in modifying a single species and the production of variations from the original type.

Be this as it may, we now have varieties that seem adapted to any place or climate, from the torrid, through the entire of the temperate, zones of the earth, in any land or country, though unknown to the rest of the world, until the discovery of the American continent by Europeans.

There have been numerous disputes as to the native country of maize, some writers wishing to prove that it has an Eastern origin; but it has not been found on any antique sculpture, neither is it mentioned by any of the ancient writers as a cereal grain of Eastern climes. St. Hilaire mentions as its native country Paraguay, Dr. Candolle believes it to have come originally from New Granada. It was found cultivated in Central America already by Columbus.

Climate, combined with cultivation, has produced the varieties we now find, and a very singular form of maize is met with growing spontaneously in the moist forests of Paraguay. Each seed of this particular corn is wrapped in a chaffy kind of husk, which husk, after two years' cultivation, disappears, and the kernels become bare like ordinary maize.

Maize may be said to be the most universal article of food cultivated by the Indians of New Mexico, Arizona, California, Nevada, and Utah, while the tribes of the Indian territory consider this grain their staff of life. The cultivation of this corn has not been acquired by them from others.

The Indians who grow it in the primitive manner, and have the original corn of America, are the Pueblos of New Mexico and Arizona. The grains vary in colour through shades of pink, blue,

and white, and the ears are generally rather small and slender. The blue variety is preferred for bread, and is sorted from the rest with much care and stored by itself. The cob or ear has fourteen rows of grains, which are full and plump, and is $6\frac{3}{4}$ inches long and $4\frac{3}{4}$ inches around. The corn, after being reduced to meal in a stone mortar, has a peculiar bluish-white appearance.

Maize is probably, with the exception of rice, the most extensively—that is widely—cultivated grain in the world. It extends from the Azores to the most southern part of Europe, being raised to a certain extent even in Asia Minor, Egypt, India, and China.

From these original growths have come the wonderfully varied and interesting varieties that now furnish so many of mankind, as well as countless lower animals, with a most important article of food. The hardihood of maize, the facility with which it is propagated, and the extent of the geographical range in which it thrives, have probably contributed to throw obscurity on the history of its introduction into the different countries in which it has been naturalised.

There are more than a couple of million farmers in the United States engaged in the raising of maize—spoken of over all English-speaking America as “corn.” Some lands produce but 20 bushels to the acre, others 150, swelling the aggregate crop of the country to vast dimensions. The Indian corn crop there would suffice to feed not only the population of the United States, but half that of Europe in addition, for a year.

Considered in its economic value, maize, according to its composition, stands in the first rank of cereals; in fact, besides its proportion of nitrogenous matter, which is nearly equal to that contained in any other grain, the pleasant and edible oil which it contains in so large a proportion, adds to its other alimentary properties. In short, very few of the productions of nature contain, like maize, all the principles necessary for the nutrition of man and animals.

In respect to size, there are varieties from 2 to 3 feet high, up to 15 and 18 feet, with the stalks and leaves large in proportion. The ears vary very greatly in size and number of rows of kernels, which sometimes reach 24, 32, or more. The grain presents a great variety in colour, from white through various shades of yellow or orange, red, brown, violet, purple, and black. By the crossing of varieties, kernels of two or more colours in stripes and blotches are produced.

In the Tuscarora and some others, the grain is dull and opaque; while in the so-called “flint” varieties the mass of the grain, the albumen, is transparent; the opaque kinds are very starchy, while the others contain large proportions of fatty matter. In the varieties known as “sweet corn” the grain is very much wrinkled and shrivelled; in these the conversion of sugar into starch is arrested, and the kernel does not fill out. The white

gourd seed is the one so used for "hominy" and cakes. Corn-cakes are a standing dish in America. The sort of maize known as the Tuscarora is often planted to furnish the table with green cobs, but it is not so fine as the wrinkled kernelled, though there is considerably more starch in it than in the latter. The rice, or "pop corn," abounds in starch; red corn is simply a variety of the "King Philip" sort, which is so highly esteemed in England.

The quantity of maize exported from America, in the form of grain and of corn-meal, is much less than that consumed by animals, constituting the exports of animals and provisions. A considerable quantity of Indian corn also enters into the American export of spirits.

Russia exports about 81,000,000 bushels of maize yearly; Austro-Hungary nearly 4,000,000 cwts.; Roumania, 668,025 tons.

Many new varieties of maize have of late been introduced into India, among which may be mentioned the Cuzco, in the hills; and the Canada, Tuscarora, Golden Dent, White Flint, and Pennsylvania yellow, in the plains. Of country varieties, the Jaunpur maize has a good reputation.

The uses of oil in Indian corn are manifold. It is obviously to protect the grain from rapid decomposition in the soil, from long-continued wet, and to retain a portion of food until needed by the young plant, as the oil is uniformly the last portion of the grain taken up. It serves to keep meal from souring readily, as flint-corn meal will keep sweet for years, even when put up in large quantities, while the Tuscarora meal will sour in a short time. There is from six to twelve per cent. of oil in corn, that of southern growth containing less than northern. The colours of Indian corn depend on that of the epidermis, or hull, and of the oil—the latter, when yellow, showing its colour through a transparent epidermis. In white varieties the oil is translucent and colourless, and the epidermis being also free from colour, the meal is white. The golden Sioux, a twelve-rowed variety, is coloured by the oil. Red and blue owe their lively hues to the colour of the epidermis, and not to the oil. On inspecting very thin slices of corn under the microscope, the epidermis is found to be made up of hexagonal cells, much larger than those of the glutinous and oily parts of the grain. The starch globules are distinctly seen in the starchy part; a drop of diluted tincture of iodine brings out their forms and character with beautiful distinctness. The phosphates are probably in the state of a fine powder, while the ammonia is, in combination with the organic matters, forming a kind of *amidon* in the mucilage around the germ.

Dr. Salisbury has furnished an analysis of five leading varieties of Indian corn:—1. Golden Sioux, bright yellow, twelve-rowed, frequently having fourteen rows. 2. Large eight-rowed yellow. 3. Small eight-rowed. 4. White flint. 5. Ohio dent, one of the largest varieties.

Constituents.	1	2	3	4	5
Starch	36·06	40·85	30·29	49·22	40·34
Gluten	5·00	4·62	5·69	5·40	7·69
Oil	3·44	3·88	3·90	3·71	4·68
Albumen	4·42	2·64	6·00	3·32	3·40
Casein	1·92	1·32	2·20	0·75	0·50
Dextrine	1·30	5·40	4·61	1·90	3·00
Fibre	18·50	21·36	26·80	11·96	18·01
Sugar and extract..	7·25	10·00	5·20	9·55	8·30
Water	15·02	10·00	13·40	14·00	14·00

Maize may be divided into two kinds, table maize and farm maize. Only the white Georgian maize is used by the Americans for table purposes, all the yellow varieties for flour and cattle food. Besides being useful for human food, Indian corn meal is excellent for fattening stock, milch cows, sheep, and poultry. It is much used in dry summers in the States as green forage, the stems being then very sweet and agreeable to cattle. Where much Indian corn is grown in America, the husks of the ears are saved, and used for stuffing mattresses, bolsters, &c., and it is a material always clean, sweet, and elastic. Paper is also made of the husks of a good quality for wrapping. The dry stems and leaves also make fair fodder for cattle.

Indian corn is the staple and peculiar food crop of the United States, although it is also grown in many other countries; but there it is harvested by hundreds of millions of bushels per annum. Whenever Europe is short of food, America stands ready to supply the deficiency with the excess of her corn crop, the superabundance of which she is obliged at present to fatten swine and live stock on, or to convert into whisky.

The varieties of corn are numerous, and are continually increasing by improvement, and the introduction of seed from one section to another, and these have become considerably intermingled. It would be almost impossible to enumerate the many varieties now cultivated, or to give the reasons why one is preferred above the others. With proper cultivation in an ordinary season, the crop should not be less than 60 bushels to the acre; 100 bushels is not an uncommon yield. The New York State Agricultural Society requires a yield of 80 bushels to the acre, to be entitled to a premium.

Here are the names of seventeen varieties grown there:—

- No. 1. Dutton corn.
2. Eight-rowed yellow.
3. Sweet corn.
4. Eight-rowed white.
5. Red blaze.
6. Sixteen-rowed Dutton.
7. Twelve-rowed red.
8. Sixteen-rowed red.
9. Early Canada.

- No. 10. Red pop.
11. Blue pop.
12. White pop.
13. Yellow pop.
14. Mixed pop.
15. Eight-rowed yellow.
16. Ohio flint.
17. Rocky Mountain corn.

Two hundred varieties of Indian corn were shown at the London Exhibition of 1862, from the Modena Royal Botanical Gardens, collected by the late Professor Giovanni Brignoli, and thirty-five varieties by Professor Parlatore of Turin.

Common preference, as well as chemical analysis, proves that the round northern yellow variety contains the most nutriment, and is in all respects best adapted for the consumption of people living in high latitudes. The white variety, by its resemblance to wheaten flour when manufactured, meets with a ready sale where the difference is not known, or where appearance is alone consulted. The principal varieties, which may be distinguished by the number of rows or grains on the cob, and the colour, shape, or size of the kernels, may be classified and described as follows:—

1. *Yellow Corn*.—Golden Sioux, or northern flint corn, having a large cob with twelve rows of moderate-sized grains; very oily. This is regarded as one of the best varieties for fattening animals or for human food. By skilful tillage, 130 bushels have been raised to the acre, weighing 9216 lbs. in the ear; when dry, 75 lbs. of ear gave a bushel of corn shelled.

2. *King Philip*, or the eight-rowed yellow corn. Its ears, which contain only eight rows, are longer than those of the Golden Sioux, and it will yield about the same quantity of oil. It is a hardy plant which belongs to a high latitude; grows to about 9 feet in height; stalks small; ears from 10 to 14 inches in length.

3. *Canada Corn*, or eighteen-rowed yellow corn, which is smaller, earlier, and more solid than any of the preceding, contains more oil than any other variety, except the rice corn and the pop corn. It is exceedingly valuable for fattening poultry, swine, &c., and is grown by many in gardens for early boiling.

4. *Dutton Corn*.—The cob sometimes grows to a length of 14 or 15 inches, but the grain is so compact on it, that 2 bushels of small ears have yielded 5 pecks of shelled corn, weighing 62 lbs. to the bushel. With proper management, an acre of ground will yield 100 to 120 bushels to the acre. As it is very oily, gives a good yield, and ripens early, it has always been a favourite variety for culture in the North.

5. *Southern Big Yellow Corn*.—The cob of this corn is thick and long, the grain much wider than it is deep, and the rows unite with each other. The grain contains less oil and more starch than the northern flint kinds; yet its outward texture is somewhat flinty, solid, and firm. It comes to maturity rather later, affords an abundant yield, and is much used for fattening animals.

6. *Southern Small Yellow Corn*.—The grains of this variety are about the size and shape of those of the Tuscarora corn, but differ from them in containing an abundance of transparent colourless oil, which may be easily seen through the clear pellucid hulls. The farinaceous parts of the grains are white, and as the quantity of oil which they contain is large, the flour or meal is more substantial as an article of food, and less liable to ferment and become sour.

7. *Southern Little White Flint Corn*.—The kernels of this variety are smaller than those of the preceding, and much resemble them in shape, but they are more firm and solid, contain more oil, and consequently are of greater value for feeding poultry and swine, and for human food.

8. *Dutton White Flint Corn*.—A variety, not differing materially from the yellow Dutton corn, except in the colour of the oil.

9. *Early Canadian White Flint Corn*.—Cultivated principally for early boiling and roasting while green.

10. *Tuscarora Corn*.—The ears contain from twelve to sixteen rows of grain, which are nearly as deep as they are broad, of a dead whitish colour on the extreme end, and entirely composed within of pure white dextrine, except the germs. As it contains neither gluten nor oil, it may be profitably employed in the manufacture of starch. It is much softer and better food for horses than the flinty kind, and if used before it becomes sour, may be converted into excellent bread. It is also an excellent variety for boiling when green, or in the milky state.

11. *Fine White Flint Corn*.—The ears of this variety contain twelve rows of rather white, roundish, thick grains which are filled with a snowy white flour composed principally of starch, but contains neither gluten nor oil. As it possesses similar properties with the preceding variety, it may be profitably used for the same purpose. It is also an excellent kind for boiling, when green.

12. *Virginia White Seed Corn*.—The ears of this corn, which are not very long (nor is the cob so long as those of the big white or yellow flint), contain from twenty-four to thirty-six rows of very long narrow grains. These at their extreme ends are almost flat, and grow so closely together from the cob to the surface, that they produce a greater yield than any other variety in proportion to the size of the ears. They contain more starch, and less gluten and oil than those of the flint kinds, and from their softness serve as better food for horses, but are less nourishing to poultry and swine. This variety ripens later, though it is more productive than any other kind.

13. *Early Sweet Corn*.—There are two kinds of this corn; one with the cob red, and the other white. The ears are short, and usually contain eight rows, the grains of which, when mature, are of a higher colour, and become shrivelled, appearing as if they were unripe. It contains a very large proportion of the phosphates, and a considerable quantity of sugar and gum, though but little starch. It is extensively cultivated for culinary purposes, and is delicious food when boiled green.

14. *Rice Corn*.—A small variety, with small conical ears, the kernel terminating in sharp points, which give them the appearance of burrs; the kernels in size and shape something like rice. It contains more oil and less starch than any other kind, and when ground, its meal cannot be made into bread alone, but is dry like sand. From its oily nature, and peculiar size, this corn is well adapted for feeding poultry.

15. *Pearl Corn*, commonly called pop corn, from the fact of its being used for popping or parching. The ears of this variety are small, the grains are sound, of various shades of colour, the white of a pearly appearance; and contain with the rice corn more oil and less starch than any other variety.

16. *Chinese Tree Corn*.—This is a pure white variety, a very handsome ear, about 10 inches long, has ten rows, grain very closely set, long and wedge-shaped, well filled out to the end of the cob, some of the grains slightly indented. One peculiarity of this corn is, the ears grow on the buds of the branches, hence its name *tree corn*. It is said to yield from one-third to one-fourth more than the common varieties; when ground into meal, it is handsomer and better flavoured than the common varieties of white corn. There are generally two ears on a stalk, and often three.

There are many other varieties, but the foregoing list embraces most of those worthy of cultivation.

The corn-growing of the States is immense. Maize is now successfully cultivated in nearly every part of a tract of country that extends 1000 miles from north to south, and even more than that from east to west.

It is the principal grain used in all parts of the Union for fattening cattle, swine, sheep, and poultry. It is used for those purposes, not only on account of its cheapness of production, but for its intrinsic nutritive properties.

The late Judge Buel, of Albany, was a great advocate for the growth of maize. He used to say that it was as indispensable to a Yankee as the potato to an Irishman, or the oat to a Scotchman; that there was no crop more beneficial to the farmer than Indian corn, that it was the meat, meadow, and manure crop of the farm, that it was convertible into human food in more forms than any other grain, and that its value in fattening domestic animals was not exceeded by any other product of the farm. The uses of Indian corn are very numerous; when very young we are told the small young stalks of thickly-sown crops are cut over by the Mexicans as an article for the dessert, and almost every one relishes green corn in its season. Then there are various preparations of the grain, such as johnnycake, hominy, mush, samp, succatash, pop corn, &c.; and now it is largely used as a substitute for arrowroot, known in Britain as "Oswego flour," and "corn starch." The use of the Indian corn plant for soiling cattle has long been known and recommended, also for winter fodder when pasturage and meadow threatened to fail.

According to the report of the Commissioner of Agriculture in Washington, the maize culture extended over 75,694,208 acres in the United States in 1886, that being over one-third of all the land under tillage in the Union.

The production of maize in the United States has gone on steadily increasing, as is shown in the following official return for the past ten years, in Winchester bushels:—

Year.	Production.	Export.	Local Consumption per Head.
1877	1,342,558,000	72,652,611	26·38
1878	1,388,218,750	87,884,892	26·61
1879	1,754,591,676	99,572,329	33·00
1880	1,717,434,543	93,648,147	31·55
1881	1,194,916,000	44,340,683	21·79
1882	1,617,025,100	41,655,653	29·09
1883	1,551,066,895	46,258,606	27·09
1884	1,795,528,000	52,302,550	30·52
1885	1,936,176,000	64,829,617	32·03
1886	1,655,441,000	..	..

The local consumption (much of which is used for stock, &c.) per head seems now to be about 30 bushels, and the percentage export of the crop has declined to about 3 per cent., against $6\frac{1}{2}$ per cent. in 1877 to 1879.

In Brazil maize is largely cultivated, especially in the southern provinces, where, in the shape of bread, meal, and farina, it constitutes a wholesome and nutritious food. It comes to market in a variety of forms. As a rule, maize yields there an average of 150 for one; it is not rare, however, to meet with soils which give from 250 to 300, and on the island of Fernando de Noronha 400 for one have frequently been harvested. In the province of Parana 36 varieties of maize are grown.

Maize is grown in most of the South American States. In the province of Parana they have about 36 varieties. The exports from Buenos Ayres in 1882 were 107,327 tons, and in 1883, 18,634 tons. In Venezuela there are 48,750 acres under maize, producing annually about 120,000 tons.

The Australian colonies are greatly dependent upon the farmers of New South Wales for their supply of maize. Upwards of 4,000,000 bushels are grown. The yield is about 38 bushels per acre. Victoria produced in 1888 318,551 bushels.

In the year 1886 there was the following extent of land under culture with maize in Australasia:—

Colonies.	Acres.	Yield.
		Bushels.
New South Wales	146,957	3,825,146
Queensland	75,566	1,709,673
Victoria	4,901	231,447
Western Australia	171	3,933
New Zealand	4,720	..

In 1885 there were 132,709 acres in New South Wales sown for grain, and 4785 acres for forage for cattle. The yield of maize in that year was 4,336,163 bushels.

The species grown are the yellow, red, and white varieties, with grain all more or less flat, and none of the round sorts. Some of

the descriptions are said to develop in ninety days, and the yield of a few is 100 bushels per acre. In Queensland maize yields heavy crops upon the rich alluvial soils of the river banks.

There are several varieties of maize grown in Australia, known by the names of Richmond River, Mackay, Queensland, Hogan, &c. The Richmond River variety is a dwarf kind, the stalk short, and the cobs small.

The Mackay has large cobs, the grain is also large, but flat and square shaped. The stalk is bulky and stands 9 or 10 feet high. This is a good variety, well worth general cultivation. The Hogan variety is small sized and inferior to the preceding.

The rapidity with which maize has spread all over the *Indian Empire*, until it must now rank as one of the most important food-crops, is a powerful proof of its being a modern introduction, since so useful a plant was certain to have taken its present position thousands of years ago had it existed in the country at all. While cultivated extensively in every district of India, it is not exported, but is either eaten green as a vegetable or is matured as a grain crop. Maize is not very much cultivated in Southern India, except as a garden crop, and is not so productive as in America. It is largely grown in Upper India and the Himalayas, where it is an important article of food of the poorer classes.

Maize is now widely distributed, not only over India proper, but in Burmah, and is universally used for human food. Baden Powell observes in his 'Punjab Products' that "maize grows everywhere throughout the hills, and appears to flourish well in a temperate as in a tropical climate. At 7000 feet or more it is the favourite crop of the people, and for six months of the year forms their common staple of food. Although superseded in the valleys by rice, there is always a little plot of maize around the cottage of the peasantry, which is reserved for themselves, while the rice is disposed of to wealthier classes. To the uplands maize is an admirably suited crop. It is very hardy, requires little rain, and is rapidly matured. In sixty days from the day of sowing the cobs are fit to cut, but the grain will not keep. Weevils attack it in preference to any other grain, and it is a popular saying that the life of maize is only a year long."

Cochin China.—There are about 9000 acres under culture with maize.

Natal.—By far the most important grain crop of this colony is maize, which is there known as "mealies." It thrives everywhere, from the mountain tops to the sea, and furnishes no small part of the fare in every settler's household, and is a valuable food for all descriptions of stock and poultry. The average yield of this cereal here is from 18 to 45 bushels per acre, although 90 have been reaped. The quantity produced in 1884 was over a million bushels. When finely ground it is the staple food of the natives, and has been accepted in preference to rice by the Indians. The white population use it largely in place of oatmeal for porridge, and when broken or crushed it is the general food for horses and mules.

Fiji.—Maize is a cereal of considerable importance, which grows luxuriantly and yields two crops per annum. There are about 3000 acres under cultivation, which mainly supplies the New Zealand demand. The production in 1885 was 65,000 bushels, of which 15,600 was exported. The home consumption has considerably increased within the last few years. A good deal of the maize-growing land has also been planted with sugar canes.

Indian corn was at one time greatly recommended for making sugar, and many experiments were tried with it in the United States, but it evidently did not prove profitable. This, by-the-way, was no new use for this plant, as Prescott, in his 'History of the Conquest of Mexico,' after noticing several of the most important articles of their industry, says that the great staple of the country, as indeed of the American continent, was maize or Indian corn, which grew freely along the valleys and up the steep sides of the Cordilleras to the high level of the tableland. The Aztecs were as curious in its preparation and as well instructed in its manifold uses as the most expert New England housewife. Its gigantic stalks in these equinoctial regions afford a saccharine matter not found to the same extent in northern latitudes, and supplied the natives with *sugar* little inferior to the cane itself, which was not introduced among them till after the conquest in 1519. Indian corn is also largely used for distilling all over North America, and in South America it appears to have been made into *Chica* or maize beer at a very remote period—it was a common drink of the Indians long before the Spanish conquest. It was generally made in a similar manner to ordinary beer. The liquor is said to be of a dark yellow colour, with an agreeable slightly bitter acid taste; it is in universal demand on the west coast of South America, and is consumed in vast quantities by the Mountain Indians; scarcely a single hut in the interior is without its jar of this favourite liquor. In the Western States cattle and pigs are turned into the corn-fields and there fatten for the market, thus saving all harvesting. In England it is used for feeding pigs, either whole or ground into meal, and also for feeding cattle when fattening during winter. It is excellent for feeding to milch cows during winter and spring, and is sometimes fed to horses; indeed, all kinds of stock on a farm—horses, cattle, sheep, pigs, and poultry—will readily eat, and seem fond of Indian corn. We hear of corn being sometimes used for fuel in the West, where wood and coal are scarce and dear, and corn is cheap. In Illinois and other parts they use the corn cobs chiefly for summer fuel; when kept dry they burn well, and are no bad substitute at that season for wood or coal. There is no doubt that this plant can be much improved by selection and cultivation, and that varieties may be multiplied to almost any extent by judicious selection of kinds, and crossing by careful impregnation. Almost every corn-grower has his favourite kind; but scarcely any kind will thrive better than the common eight-rowed yellow corn. Though Indian corn is a tropical or sub-tropical plant, yet it is capable of being acclimatised in almost any region up to nearly the 50th degree of

latitude on the American continent, and is adapted in some of its varieties to almost any part of the country. Being a short-lived annual it will succeed wherever the heat of summer is intense and of sufficient duration, whatever may be the cold of winter.

In *Italy* maize is an important part of the cereal crop, and the produce exceeds 80,000,000 bushels. How largely it enters into the agricultural economy of the country may be seen from the fact that in certain parts, the province of Turin for instance, the labourer is allowed to share the produce of the Indian corn with his master. In other parts of Lombardy, besides a money payment for wages, he receives a proportion also, which, when mixed with rye and millet flour, is made into a coarse bread. Amongst the better paid a "polenta" of corn meal is principally eaten: this, mixed with vegetables and flavoured with a little bacon, is a favourite dish.

In the south of Europe and on the banks of the Danube the cultivation has been attended with considerable success. In Hungary, in particular, the crops of maize are large and profitable, some 3,500,000 acres yielding 81,000,000 bushels.

In the Austro-Hungarian Empire the production is returned at 83,000,000 bushels. In Greece the production amounts to about 3,000,000 bushels.

In Portugal Indian corn is the staple cultivation of the northern part, and the produce amounts to about 15,000,000 bushels.

In France the production is stated to be 25,000,000 bushels, and the grain is grown chiefly for poultry, which, in the sub-divided condition of the soil, is one of the mainstays of the peasant farmer.

The production of maize in different countries in 1886 was as follows:—

	Bushels.		Bushels.
United States	1,665,441,000	New South Wales	4,000,000
Hungary	83,000,000	Venezuela	3,360,000
Italy	82,500,000	Greece	3,000,000
France (with millet) ..	26,827,710	Natal	3,000,000
Russia	16,704,727	Queensland	2,000,000
Portugal	15,000,000	Fiji	70,000

In Algeria much attention is not given to the culture of maize, as it requires good land and irrigation. It is sown in March and April, according to the season. The forty days' variety is harvested in June, the larger kinds in July and August. The mean produce on irrigated land is 18 to 20 cwts. per hectare; on dry land it is not a third of this.

There is a small sweet variety grown in Demerara, called *cariaca*, which ripens its grain in less than two months from the time of sowing. It is in every respect more diminutive than the ordinary Indian corn, being very slender in its stalk, and with the leaves and ears also small in comparison with the ordinary kinds. The flavour of the *cariaca* is very fine roasted in the milk, that is, before the grain is fully ripe, when it is very soft and juicy. Indeed, it is usually prepared in this way, and seldom permitted to arrive at maturity. You see the negroes munching

the grain off the roasted cob. The natives sometimes crush and bake it, and it makes a nutritious, juicy sort of bread, which they call "cachapo."

Maize Starch.—A large quantity of Indian corn is employed in America and this country in making starch, or what is known as corn flour and maizena. In this manufacture the maize is softened in a solution of carbonate of soda and crushed in mills, on which water is poured. The milky liquid which flows is diluted with water, and conveyed over a large sieve on an inclined surface, the fibres, &c., being left on the sieve. The starch is deposited on the inclined plane, while the fatty and nitrogenous substances pass off with the liquid into the vat. The starch is collected, washed, and dried. The residues remaining on the sieve are employed for feeding stock and in paper-making, the oil or fat in soap-making.

RICE.

One of the most extensively diffused and useful of the grain crops, and that supporting the greatest number of the human race, is rice. It occupies, in fact, the same place in most intertropical regions that wheat does in the warmer parts of Europe, and oats and rye in those more to the north. It is raised in immense quantities in India, China, Java, and most eastern countries, in parts of the West Indies, Central America, and the United States, and in some of the southern countries of Europe. The chief food of perhaps one-third of the human race, it affords the advantages attending wheat, maize, and other grains, while it is susceptible of cultivation on land too low and moist for the production of other useful plants.

The uri or wild rice, plentiful in the marshy tropical countries of Southern Asia, is, without doubt, the plant from which all our forms of cultivated rice have been derived. The probability is that the cultivation of rice commenced in China and spread to India, being introduced into Egypt at a comparatively recent date. The Greeks became acquainted with it through Alexander. In Europe it was first cultivated in 1468 in Italy.

The rice from the Southern States of America is decidedly the best brought into commerce, being much sweeter, larger, and better coloured than that from Asia, where its cultivation is not so well managed. It is necessary to except Bengal rice, which now nearly equals that grown in the Carolinas. South Carolina produces the best American rice, and Patna the best East Indian variety. Excellent rice is also grown in the Spanish provinces of Andalusia, Valencia, and Catalonia, as well as in the marshes of Upper Italy, especially Lombardy and Venice, and in the plains of Milan, Mantua, Verona, Parma and Modena, along the river Po.

The general imports of rice into Great Britain, the Dutch, Belgian, and German ports, average about 700,000 tons; in 1881 they reached 849,812 tons, and in 1887 were only 670,414 tons.

The principal eastern ports and countries from whence rice is shipped to Europe are: Java, Akyab, Rangoon, Bassein, Moulmein, Saigon, Calcutta, Madras, Bankok, and Japan. The shipments from these were in 1887 as follows, in tons:—

Countries.	To Europe.	Total.
Java	18,544	71,252
Akyab	164,000	200,000
Rangoon	346,300	567,800
Bassein	118,400	118,600
Moulmein	48,400	67,600
Saigon	25,000	303,833
Calcutta	49,000	..
Madras	3,681	..
Bankok	63,000	..
Japan	33,200	..

Holland received 101,292 tons of rice in 1887.

The British imports of cleaned rice were derived from the following sources:—

Countries.	1875.	1886.
	Cwts.	Cwts.
Holland	51,369	228,429
Siam	110,216	114,978
Bombay and Scinde ..	32,486	21,988
Madras	182,265	1,596
Bengal and Burmah ..	6,251,319	5,839,799
Other countries	42,239	350,423
Total	6,669,894	6,557,213

The Carolinas and Louisiana produce annually about 420,000 cwts. of rice; in 1880 the produce was only 250,000 barrels; the Brazilian rice comes into commerce from Rio Janeiro, and the Egyptian from the Delta of the Nile, viâ Damietta and Rosetta.

The following table shows the imports into the United Kingdom, of rice cleaned, and in the husk, or uncleaned, at decennial periods:—

Year.	Cleaned.	Paddy.
	Cwts.	Qrs.
1840	443,918	42,119
1850	785,451	37,150
1860	1,535,575	516
1870	4,077,468	98,178
1880	7,889,710	..

It will be seen how enormously the trade has increased. About half the quantity received is re-exported to the Continent, &c.

The varieties of rice are very numerous in the different countries where it is cultivated. The natives of India and China distinguish them a good deal by the size, shape, and colour of the grain. There are white and red rice, small and large-grained. The chief commercial classifications, however, in the East are, table rice, cargo rice, and white rice.

Loureiro enumerates the following species: *Oryza communissima*, *glutinosa*, *montana*, *mutica*, and *praecox*, all of China; other authors consider them only varieties of *O. sativa*. Then we have *O. latifolia*, Desv. of the Carolinas and St. Domingo; *O. minuta*, Presl. of Luzon; *O. Nepalensis*, G. Don; *O. perennis*, Moench, and *O. platyphylla*, of New Granada.

Although there are such innumerable varieties cultivated, practically they resolve themselves, agriculturally, into two kinds—the upland or mountain rice, and the lowland or aquatic rice. Some forms of rice are temperate, and grow on the hills, often ascending to 8000 feet in altitude; others occur on the inundated plains, or over deep marshes, luxuriating in a tropical climate. These frequently grow up with the rising water, until they attain a height of as much as 20 feet. Soil, climate, and mode of cultivation, during the lapse of centuries, have doubtless all combined to produce from a common stock the multitude of forms with which we are familiar. Some forms of rice are scented, while the majority have no smell whatever. Scented rices are common, for example, in Orissa and Behar, and are much prized by certain classes of people. The better-class natives eat the long thin white rices, chiefly cultivated upon higher lands; while the short, thick, more or less reddish rices—the so-called Patna rices—are those eaten by the mass of the people of India. The Mahomedans prefer an absorbent rice, such as that from Pilibhet. In Burma, amongst many other high-class rices, a grain is grown, which, while largely used for industrial purposes, is regarded as unwholesome as an article of food. One of the most curious peculiarities recently brought to light regarding rice is, that while the great mass of rices contain only one grain within the husk, two or even three grains are regularly present in certain other rices.

Java rice is inferior to that of Bengal or Carolina. This is not attributable to any real inferiority in the grain, but chiefly to the careless mode in which it is prepared for the market. In husking the grain it is much broken; and from carelessness in drying, it is very subject to decay, from imbibing moisture, and the attacks of insects. Unhusked rice or paddy may be kept sound for many years; indeed, for table use, rice a year old is usually preferred by judges. Of all the cereals it is the most compact, seldom weighing less than 65 lbs. to the bushel.

Rice does not contain half as much gluten as wheat, but has one-fourth more starch in its composition, hence the preference given to it by our starch-makers, both from its cheapness and larger yield.

Professor Johnston found the proportions of water in rice to be as follows:—

Madras	13·5
Bengal	13·1
Patna	13·1
Carolina	13·0

Mr. Dugald Campbell, in a series of analyses (published in my 'Technologist,' vol. i. p. 191) on the amount of starch in rice, found in four samples of pinky Madras rice an average of 13·57 per cent. of water, and the proportions of starch in four qualities were:—

First quality.. .. .	76·6
Second „	73·0
Third „	70·2
Fourth „	69·1
Average of the four specimens	72·2

The following analyses are given by Dr. Watson as the composition of the several varieties of rice named:—

—	Pegu.	Bombay.	Broach.	Bareilly.	Pulut Maulmein.
Moisture	13·50	13·00	13·10	12·80	12·90
Nitrogenous matter	7·41	7·44	7·15	8·24	7·24
Starchy matter	78·10	77·63	78·70	77·80	78·56
Fatty or oily matter	0·40	0·70	0·49	0·64	0·60
Mineral constituents (ash) ..	0·59	1·23	0·56	0·52	0·70
Total	100·00	100·00	100·00	100·00	100·00

In Europe, America, and Africa the cultivation of rice is comparatively insignificant. It is in the intertropical countries of Asia that rice is of the very first importance. Over the seaboard of the peninsulas of India and China, in Japan, and some of the eastern islands, it holds undisputed sovereignty.

Italy.—To the Moors has been attributed the introduction of rice into Spain, and subsequently to Italy. From the Venetian provinces it extended rapidly through the marshy tracts so common in that region. The great swamps of Verona and Mantua, useless for other species of culture, afforded a profitable field for rice; in them it was early established, and has always continued to be of great importance. Its progress to the eastward was slow, and it was not until the middle of the sixteenth century that the rice cultivation of the Milanese became of sufficient extent to attract public attention to its sanitary relations. Its development thus kept pace with the progress of that great system of irrigation canals which had been perfected at this time.

In Piedmont and Lombardy rice cultivation is divided into two classes—permanent, locally termed *risage da zappa*, from the use of the spade in its tillage; and temporary, *risage da vicenda*, which

forms a part of the rotation of crops in the irrigated districts. The permanent rice cultivation is restricted exclusively to low marshy localities, unsuited for any other culture, and is of great value, being the only crop which soils so wet are capable of affording when introduced into the rotation. This extends over nine years, generally in the following order: 1st year, wheat with grass seeds; 2nd, 3rd, and 4th, meadows; 5th, 6th, and 7th, rice; 8th and 9th, Indian corn, or other crops, varying from year to year.

A clayey impervious soil, with a small proportion of sand near the surface, is found to be the best for rice. As the plant passes its existence in water, the details of the culture are directed to securing this condition. The means employed are much the same in Italy as in India. The surface of rice-land is made as nearly as possible horizontal, and where variations of level occur, a series of terraces is formed, each of which is carefully levelled. Compartments are then marked out, of which the dimensions are extremely variable, and each is surrounded by earthen walls or banks about two feet high. Connection is established between the compartments at high and low levels, so that the water entering the first passes into the others, and thus maintains a very gentle movement, which keeps the supply always fresh. When the divisions are duly formed, the rice-ground is ploughed and carefully weeded in spring.

If the soil be too wet for the use of the plough, as in marshy localities, it is broken up by the spade, a tedious and unhealthy process. After the ground has been thus prepared, water is admitted for the purpose of verifying the levels, and of consolidating the partition-walls of the different divisions. It is necessary to remove all trees from the immediate vicinity, as shade is very hurtful to the crop.

The period of sowing extends from the beginning of March to the beginning of May. The new rice-lands are sown first; those which have been established for one or more years at a later period, as the soil is benefited by exposure for some time to the heat of the sun. Rice in the husk, locally termed *risone*, is employed as seed in the proportion of from three to four bushels per acre, according to the nature of the soil. It is sown by hand, and as the land is literally in the state of mud, it is very laborious and unhealthy work for the cultivators. It is usual to soak the rice-seed in water for twenty-four hours previously, with the double object of quickening its vegetation and preventing its floating on the surface of the water, as without this precaution it occasionally does.

Twelve or fifteen days after the sowing the young plants rise above the surface of the soil, and as they increase in height, the sheet of water is gradually increased with them, so that merely their tops show above it. The fields are kept in this flooded state until the plant flowers, which, according to the time of sowing, takes place between the middle of July and the middle of August. About this time the flooding of the crop is replaced by regular but

abundant irrigation, at intervals of a few days. When the head becomes well formed, the grain of good size, and the colour changes from deep to lighter yellowish green, all use of water is discontinued, the land is drained as dry as practicable, and in ten or fifteen days afterwards the crop is ready for cutting. The rice harvest in the north of Italy ranges, according to circumstances, from the middle of September to the beginning of October, and the crop is cut with the scythe when large compartments are used, and with the reaping-hook in the smaller ones. The grain is made into small sheaves about 25 lbs. or 30 lbs. in weight, and with a constant length of 18 inches. When the plants are longer than this they are cut higher, and the stubble is afterwards ploughed in as manure.

The thrashing is effected after the Oriental fashion by the treading of bullocks or horses, and the grain is subsequently dried for some days by exposure to the sun. It is then stored, and, during the winter, when water is cheap and abundant, it is cleared of the husks in the rice mills attached to the farms, which are worked by water power. Throughout Northern Italy the meadow and rice lands may be said almost to divide between them that vast volume of water which is every year poured over the face of the country. The average production of rice here is about 20,200,000 bushels.

Italy exported the following quantity of rice :—

			Kilos.				Kilos.
1862	..	..	26,666,820	1880	..	..	31,931,000
1870	..	..	86,681,044	1886	..	..	24,111,000

India.—It is impossible to give anything like an approximate estimate of the land under culture and the annual production of the great rice-growing countries of the East ; but a few incidental facts may be stated.

The area under rice in India may be put down roughly at 60,000,000 acres, of which Bengal has 37,500,000. Out of 4,000,000 acres of cultivated land, about 3,700,000 are in British Burma annually under rice cultivation.

ESTIMATED ACRES UNDER RICE in INDIA in 1886.

Madras	..	..	..	..	..	..	5,795,644
Bombay	..	..	..	..	..	..	1,950,527
Bengal	..	..	..	..	..	..	37,500,000
North-West Provinces	..	..	..	..	..	..	3,934,521
Oudh	..	..	..	..	..	..	2,159,525
Punjab	..	..	..	..	..	..	597,002
Central Provinces	..	..	..	..	..	..	3,170,360
Lower Burma	..	..	..	..	..	..	3,704,990
Assam	..	..	..	..	..	..	1,128,893
Coorg	..	..	..	..	..	..	73,805
Berar	..	..	..	..	..	..	25,833

60,040,999

The rice continent of the world is Asia, and in Asia, British India is pre-eminent as the territory where rice cultivation most prospers.

At least three-fourths of the rice that forms the export trade of the world is exported from British India. Bengal rice finds its way wherever coolies emigrate, and no other rice seems able to compete with it in the market.

The rice exported from Calcutta is divided broadly into three qualities—table rice, ballam, and moonghy; of these, table rice is of course the best quality. Ballam is mostly Backergunge and Eastern Bengal rice; the name may be supposed to be derived from the Chittagong boats of peculiar construction in which the rice is carried, called ballam boats. The moonghy is common or inferior rice. To the United Kingdom the exports in the largest proportion are of table rice; and similarly to Bombay and Australia, where it is intended in the first instance as food for Europeans. The rice exported from Calcutta is table rice. To the Mauritius, however, the exports are ballam and moonghy, being in the proportion of 150 tons of ballam and 75 of moonghy to 15 tons of table rice, and the same to Bombay and the West Indies. To the Straits, to Java, to the Maldives and Laccadives, to Ceylon, to Madras and the Coromandel Coast, and to the Gulfs, the export is almost entirely of ballam rice.

At the Calcutta Exhibition in 1883, 4000 apparently distinct forms of rice were shown from the Presidency of Bengal, arising from differences of climate and varieties of soils, and the vast antiquity of everything purely native. It is, in fact, impossible to say that the corresponding rices of any two districts are the same, local varieties in this being much greater than in any other cultivated cereal. It seems probable that if all the provinces in India were to be worked up with the same degree of care as was done in Bengal, the total number of recognisable forms of rice would be little short of 10,000.*

There are over 1400 different specimens of rice in the Calcutta Museum. Probably there does not elsewhere exist an equally extensive and valuable collection of this cereal. Of paddy there are in Bengal three well-recognised classes—the *Aus*, the *Aman*, and the *Boro*. They may be shortly distinguished as follows:—

The *aus* is sown from April to May, and is cut in August and September. It does not grow in water, is coarse, and is not largely produced. The *aman* or floating rice is sown between the middle of May and the end of June. It requires showers of rain even in its early days, but the young plants should be strong before the regular rains set in. It is cut in November and December, and constitutes the staple crop of the country. The *boro* is sown in January and February, or somewhat earlier; is planted out in low marshy places, and harvested in April and May.

Two harvests are all but universal in Bengal, with an occasional third, but smaller one; two crops are frequently taken off the same field.

* Calcutta Exhibition, Jury Reports, vol. i., p. 254.

The number of varieties of paddy in the three different classes together is something enormous, when compared with anything of the kind to which we are accustomed in England. Ten or a dozen names each would probably cover all the different sorts of wheat and barley with which the practical English farmer is brought in contact. But there are as many as 1300 names of paddies, and, though very many of these are merely local synonyms, a large number unquestionably correspond to intrinsic and seasonal distinctions.

The obvious differences in the grain itself are indeed very remarkable. In colour the specimens range from a bright golden hue, through almost every gradation of tint, to black. And in regard to size, they vary from the dimensions of a large mustard seed to those of a cantaloup melon seed. Some 200 or 300 of the samples of paddy in the Calcutta Museum have been tested by weighing, and of these the smallest furnished $203\frac{1}{4}$ grains to the half drachm, the largest $54\frac{1}{4}$ grains.

It has not yet been ascertained what are the external conditions of season, situation, and culture, which give the different sorts their respective economic values; and investigation on these points forms part of the work which is yet reserved to be accomplished in Calcutta.

The husked rice, or rice proper in the understanding of English people, exhibits, necessarily, differences of size corresponding with those of its parent grain. It also varies in tint from a pure white colour to a dull red. The proportionate out-turn of rice to the unhusked paddy from which it arises, depends both upon the sort of grain and the process of husking pursued, probably also upon other elements. Dr. Buchanan Hamilton says it amounts to a little more than one-half; and a writer in the 'Statistical Reporter' gives the proportion of "rice" to "paddy" at from half to two-thirds.

American rice, from the careful cultivation to which it has been subjected, has acquired a quality far finer than that of any other rice. Persistent efforts have been made by the Indian Government to introduce the Carolina varieties into India, but hitherto with only moderate success.

The following figures may be useful as showing the immense importance of rice cultivation. Rice is the principal article of diet over Bengal proper, and among Bengalees is often the only food eaten: pulse, fish, vegetables, oil, salt, spices, and other condiments are only added to give the rice a relish. It is generally admitted that the consumption varies from two-thirds to three-fourths of a seer (about 2 lbs.) per head per diem. The population of Bengal and Orissa amounts to 44,913,305 souls; this number, therefore, at two-thirds of a seer per diem, or 6 maunds per head per annum, require nearly 270,000,000 maunds of rice. In Behar rice is still the principal food crop, though among the poorer classes, and especially in the district of Sarun, maize and barley are in a great degree the food of the people. . . . The population of Behar is 20,000,000 souls, and, allowing 3 maunds of rice per

head per annum, they require 60,000,000 maunds of rice. Bengal and Behar together, therefore, consume about 330,000,000 maunds of rice yearly, or say 12,250,000 tons; add to this an export of 1,000,000 tons and 2,000,000 tons for seed grain and waste, and the total requirements amount to over 15,000,000 tons of rice per annum. An article in the 'Indian Economist,' taking the consumption at three-fourths of a seer per head per diem, and allowing that amount for Behar, as well as Bengal and Orissa, arrived at a total requirement of nearly 20,000,000 tons of rice, or say 765,000,000 maunds of paddy. Both these calculations exclude the reserves which must be stored, and deal only with the actual yearly hand-to-mouth consumption. The area under rice in Bengal, we have seen, is 37,500,000 acres, and, at 20 maunds per acre, these would produce 750,000,000 maunds.

In India generally, it has been said, rice is produced in every variety of soil, at every altitude, and in every latitude. On an average estimate the yield of one acre of rice in the fertile soil of Eastern Bengal has been taken to be about 27 maunds of paddy, or 2,214 lbs. Rather less than 2 maunds or about 160 lbs. would be the amount of seed required in those provinces for sowing an acre; and the produce may, therefore, be estimated at thirteen or fourteen-fold. This is rather an over-estimate for ordinary Bengal produce. Twenty maunds of paddy or say 12 maunds of rice per acre is really a very good average out-turn, and a yield of seven-fold is an average beyond which few cultivators on an ordinary soil venture to calculate. In the North-West Provinces the average yield of rice is reported to be little over 10 or 12 maunds of paddy per acre, or from 500 lbs. to 800 lbs. of cleaned rice. In the Punjab the out-turn is estimated at 550 lbs., in Oudh at 649 lbs., in the Central Provinces at 207 lbs., and in Mysore at 1577 lbs. of rice per acre. It is presumed that these calculations are in cleaned rice, as it is impossible to suppose that there can be so small a yield as this of paddy or rice unhusked. The Mysore estimate, however, is apparently in paddy. In Mr. Dalsell's 'Memoir on the Famine of 1866,' it is asserted that the Revenue Settlement Department of Madras, after inquiries and experiments extending over ten years, had estimated that an acre of unirrigated land in the Madras Presidency produces on the average a yield of about 5 cwts. or 560 lbs., and that an acre of irrigated land produces 10 cwts. or 1120 lbs. of cleaned rice. The yield of paddy is said to be double the yield of cleaned rice. In Sindh the out-turn of an acre is estimated at from 900 to 1200 lbs. of paddy.

In British Burma it is reported that one acre will produce from fifty to one hundred baskets, or 2500 to 5000 lbs. of paddy, according to the class of land. On the best land somewhat less than one basket (50 lbs.) of paddy will plant an acre, while on inferior land it takes more. The yield of paddy in British Burma is, therefore, from fifty to a hundred-fold. The average on the Tenasserim coast is said to be only twenty-fold. In Siam, Cochinchina, and Java it is a common practice to exact two crops of rice yearly from the same soil, one in April and one in October, and an

English acre in Java so cultivated has been found to yield an annual produce of 560 lbs. of cleaned rice. In the same island an acre of good land yielding annually one green crop and a crop of rice was found to produce 941 lbs. of clean-grained rice or about 1250 lbs. of paddy.

It would not be difficult to reproduce many other calculations that have been made of the out-turn per acre and of the remunerative quality of rice cultivation. To do so, however, would be of little use, as the calculations are mere estimates, and are often evidently very inaccurate.

Rice is the favourite food-grain of the people of Asia; but, except in Arracan, and a few other districts, in which it constitutes the chief and almost only article cultivated, its use is confined to the richer classes throughout the country.

In Assam and Burma rice is the sole food-crop, and in Bengal about 50 per cent. of the total food-growing area is under rice, which feeds about 70 per cent. of the population.

The percentage of food-growing area under crops in different districts is as follows:—

Districts.	Millets.	Rice.	Rice-eating Population.
North-West Provinces and Oudh	34	9	19
Punjab	41	5	5
Central Provinces	39	34	31
Madras	67	33	32
Bombay	83	10	12
Behar	82	1	2
Mysore	84	16	20

In Bengal, Burma, Orissa, and the eastern portion of Central India, the southern part of Madras, and the Western districts of Bombay, rice is the principal food. In the Punjab, the North-West Provinces, and Oudh, Behar, and the northern part of the Central Provinces, and Guzerat, the poorer classes live on millets, grown in the rains, and also on barley and grain (*Cicer arietinum* and *Dolichos biflora*); the richer only use wheat and rice. In the southern part of the Central Provinces, Behar, the Bombay, Deccan, and the northern part of Madras, the larger millets are the staple foods. In Mysore, the small millet (raggi, *Eleusine corocana*) is the principal article of food. In Assam rice is the staple, supplemented with Indian corn and Job's tears (*Coix lachryma*). Wheat is chiefly grown for export, and to the inhabitants of India rice is the most valuable of all the cereals. Where rice is not cultivated in India as the staple food, the millets are exceedingly important. With the exception of Burma, rice is grown almost entirely for home consumption; and where rice cannot be cultivated, the millets invariably take its place as the staple food-crop of the mass of the people. The total area of land under millets has been estimated as 33,228,867 acres, of which Bombay has 13 million,

Madras $7\frac{1}{4}$ million, the North-West Provinces $5\frac{1}{2}$ million, the Punjab nearly 5 million, and Berar a little over 2 million acres. In Bengal millets are scarcely cultivated excepting to a small extent by the hill tribes. In 1884 and 1885 the export of millets to foreign countries was 246,000 cwts.

Rice may be said to be the staple food of the population of Southern India, and the natives are very particular as to the kind and quality of the grain which they use. Burma and Bengal grown rice does not suit the inhabitants of Madras, being apt to produce diarrhoea and indigestion. The amount of nitrogenous matter in rice is small, varying from 3 to 7 per cent., and it is also poor in fat. The Sanscrit name of rice, Dhánya, or nourisher of men, expresses forcibly the importance of this article to the people of India.

There are in Bengal, as already stated, three distinct crops: the first, grown on somewhat high ground, is the early crop, sown for the most part in June, and reaped in August and September. The second is the main crop, sown in June and July, and cut from November to January. It requires a great deal of moisture, some varieties growing in several feet of water. The third is a dwarf crop, cultivated in the months of March, April, and May, on low-lying land, generally on the sides of marshes and pools, where irrigation is easy. The ratio of productiveness is said to be, in a good season, as 1 to 35.

The following figures show the rice exported from India, chiefly to England, Ceylon, Mauritius, and the Straits Settlements. The value of that exported is about £9,000,000 a year.

RICE (INCLUDING PADDY)—EXPORTS FROM INDIA, YEARS ENDING MARCH 31.

Cwts.				Cwts.			
1877	..	..	19,914,334	1883	..	..	31,258,288
1878	..	..	18,428,625	1884	..	..	27,040,330
1879	..	..	21,250,232	1885	..	..	22,051,826
1880	..	..	22,166,308	1886	..	..	27,813,844
1881	..	..	27,266,051	1887	..	..	26,460,500
1882	..	..	28,888,436	1888	..	..	28,148,695

The exports of rice from Burma in 1885 amounted to 1,025,201 tons, the highest figure for any year except 1882. The competition of Saigon and Bangkok rice in the European markets, which was considerable in 1884, fell to insignificance in 1885. The export has been rather lower in the last four years.

The rice trade may be fairly called the most important, and, perhaps, the most lucrative in Rangoon; there being no fewer than twenty-two firms engaged in cleaning rice. The paddy brought to Rangoon is divided into three principal kinds, known as Ngatsaing, Naghchouk, and Boyoot. Of these the Ngatsaing paddy is by far the best; it has large broad grains, dark in colour, with a fine pearly kernel. The Naghchouk has light-coloured grains, long and narrow; often the husks are only partly filled, which makes it less profitable to mill than the Ngatsaing paddy. The Boyoot has small grains in appearance like Ngatsaing, only smaller, and has

a beard like barley. The Burmese prefer the rice made from Boyoot paddy to any other. The paddy is always sold by measure at so much per hundred baskets. A basket is supposed to contain 50 lbs. of paddy, and should be 15 inches diameter by 15 inches deep. The price per hundred baskets varies from 90 to 120 rupees.

The rice sent to Europe is used for food, for conversion into starch, and for distillation. What proportion is used for each purpose it is impossible to say; but the use of Indian rice for distillation is rapidly extending in Germany, Holland, France, and Italy.

About four-fifths of the total exports from Burma consist of "cargo rice," *i.e.* rice of which only one part in five is husked.

The expansion of the export rice trade of Burma is remarkable. The value of the exports is now about $5\frac{1}{2}$ million sterling, or more than £1 per head of the population. New rice mills are being built year by year at Akyab, Bassein, and Rangoon.

The narrow strip of coast between the sea and the Aeng range, which we call Arracan, covers an area of about 16,250 square miles. It is generally fertile. The deep lagoons which intersect it in every direction afford ready means of communication, and it has a fine and convenient outlet for its produce in the magnificent harbour of Akyab. The production has been developed by the small independent owners of land, until the province now competes successfully with Bengal in the supply of rice to the continent, so that the exports, which in 1830 gave employment to but a few coasting vessels, now require 1 million tons of shipping.

The Burmese recognize nearly a hundred varieties of rice, but the principal distinctions between the different kinds are as follows:—hard grain, soft grain, and glutinous rice. The "Ngatsaing" is the hardest grain, and the rice which is accordingly principally exported to Europe. "Meedo" is the chief of the soft-grain varieties. It is much preferred by the Burmese to the hard-grained sorts, and it is certainly superior in taste when cooked; but the hard-grained rice is that purchased by the merchants for export, as it keeps better, and the soft-grained rice is too much broken by European machinery in cleaning. Latterly, on the continent, this last objection appears to have been overcome, and a greater demand is consequently springing up for the "Meedo" rice for the markets of foreign Europe. The "Koungnyeen," or hill rice, is called "glutinous" rice by Europeans, from the property it possesses when cooked of the grains all adhering in a thick glutinous mass. It is the chief article of food with the Karens, and other hill tribes, but is not much eaten by the inhabitants of the low swampy plains, where the common rice is grown.

Rice, although regarded by us more as a cheap luxury than a necessary article of food, forms the chief subsistence of the Hindoos, Chinese, Japanese, and other Eastern nations. The Burmese and Siamese are the greatest consumers of this grain. A Malay labourer requires 56 lbs. monthly, but a Burmese or Siamese 64 lbs. The South Carolina people do not consume much rice themselves: they raise it principally to supply the foreign demand;

the swamps of that State, both those which are occasioned by the periodical visit of the tides, and those which are caused by the inland flooding of the rivers, being well suited to its production. The mountain rice of India is grown without irrigation, at elevations of 3000 to 6000 feet above the level of the sea, the dampness of the summer months compensating for the want of artificial moisture. Rice, which comes to us in the husk, is called by its Indian name "Paddy." Before it can be used for food, the husk must be removed: this is done in India amongst the poorer people by merely rubbing the grain between flat stones, and winnowing or blowing the husks away.

In passing between the two stones, the husk of the paddy is rubbed off, and the rice and husk come out at the edges. This is next carried to the top of the mill by means of another elevator, and passed over a winnowing machine to remove the husk. The winnowing machines usually consist of three sets of revolving fans, placed one above the other, the rice passing in front of each; any rice which may be blown out is collected and passed over another set of fans. The rice after coming from the farmers, is what is known as five part, or "cargo rice." It consists, or is supposed to consist, of five parts of rice to one of paddy, and contains a little broken rice.

To obtain white rice it goes through a further process of milling, and a considerable amount of skill is required in getting the necessary whiteness without breaking too much. White rice is generally known by three qualities—1st and best, Europe; 2nd, Straits; 3rd, Bombay. The quality depends on the degree of whiteness, the kind of paddy from which it is made, and the amount of "broken" which it contains. In some mills the rice, before being bagged, is passed through a polisher of sheep skin to smooth the surface and give it a pearly appearance. The dust or skin of the rice is sold to feed cattle and pigs, and the husks of the paddy are burnt. There are forty-four rice mills in India, of which forty are in Lower Burma.

Siam.—The principal trade of Bangkok, and the foundation on which not only its prosperity but its actual existence mainly rests is rice. This article is drawn in immense quantities, not only from the innumerable fields which line the fertile valley of the Menam, but from the adjacent rivers which flow into the gulf from the enormous watershed of the mountain crescent, which fringes the northern extremity of the kingdom. The out-turn of this grain in favourable years is scarcely to be calculated. It not only furnishes support to the native population of Siam and the Peninsula, but supplies China, Manila, the Straits, and even Java and Sumatra.

Burma and Cochin-China having the advantage of telegraphic communication with the rest of the world, and their trade being on a more regular footing, the rice from those countries is all taken away as soon as it is ready. In Siam the export, though far less on the whole than in either of those countries, continues throughout the year. There is little reason to believe that Siam will produce,

at least for some time to come, more rice than she does at present. Nothing is done to encourage the cultivators, and a system of advances made by officials on the crops is growing up, which eventually takes all profit out of their hands.

Ceylon.—The production in Ceylon in 1884 was about 5,250,000 bushels of rice, and 1,000,000 of Indian corn, millet, and other grain, but this is quite insufficient for the local demand, as about $5\frac{1}{2}$ million bushels are annually imported. There are about 604,464 acres under rice in the island, and 150,000 under maize and other cereals.

In *Cochin-China* there are 1,870,000 acres under rice, and this is yearly on the increase, as there is a large demand from surrounding countries, especially China and Tonkin. In Pondicherry about 17,000 acres, and at Karikal 11,500 acres are under rice, and the produce is about 3,600,000,000 kilos. Rice is the principal produce of French Cochin-China. It is planted in almost every province, except some of the northern districts. The export of this grain in 1883 and 1884 was 8,600,000 piculs each year. There are several rice mills in Saigon and Oholm.

China.—Rice culture extends over all the provinces of China, which combine abundance of water with the mild temperature necessary for this grain. The provinces of the south yield two harvests annually. There are many varieties, as white and red rice, large and small grain, the upland or dry rice, and the glutinous rice. The mountain rice (*Oryza montana*, Lour.), distinguished by its long grains and epidermis, would seem to be a distinct species.

The mode of culture of this plant varies considerably according to the climate and circumstances. The following is the method employed among the Chinese, who cultivate it to a very great extent in the midland and southern parts of their dominions, and the low grounds of which are annually flooded by the Kiang and the Yellow rivers. These extensive inundations are occasioned by the heavy rains which fall near the sources of these rivers, which have their origin in the Himalayan chain of mountains.

When the waters have receded, the earth is covered with a thick coating of slime and mud, which fertilizes the ground as perfectly as the richest manure. As soon as this takes place, the patient Chinese surround portions of this rich soil with clay embankments, always selecting the neighbourhood of some running stream. The ground is then carefully harrowed, and the operation is repeated until it works well. In the meantime the rice intended for seed has been soaked in water, in which a quantity of manure has been stirred; this has forwarded its growth so much that the young plants appear above the ground in two days after they have been deposited in the earth. It is necessary to remark that, during all the early stages of its growth, and until the seed is well set, the roots of the plant must be constantly under water; to effect this, different contrivances are resorted to, to keep up an adequate supply of water.

As soon as the young plants have reached the height of six or

seven inches, they are pulled up, the tops are cut off, the roots carefully washed, and the whole planted out in rows, about a foot asunder. In the course of its growth, it is sprinkled with lime and water, which is said to destroy insects and assist in enriching the soil; the greatest care is also taken to remove weeds by hand as fast as they spring up. In these tedious operations the English agriculturist can form no idea of the perseverance and attention of the industrious Chinese. The first crop, for they obtain two in the course of the year, is harvested about May or June, and the second in October or November.

The sickle employed by the Chinese for the purpose of reaping the rice is, like the European instrument, bent into the shape of a hook, but the edge, instead of being smooth, is notched like that of a saw. The straw and stubble left after the harvest are burnt on the spot and left to enrich the land.

It is calculated that the aquatic rice only yields a return of 25 for one, but that it might yield up to 80. The upland or mountain rice is, however, said to be more profitable, for it is not unusual to obtain 100 to 120 for one. This abundance is explained by the habit which rice has to tiller, and a single grass will often produce many stems, crowned with numerous spikes of grain.

Formosa.—The chief agricultural crop in this island is rice, grown in irrigated, or rather inundated fields. Much labour and skill must have been bestowed upon the levelling of the fields and the provision of the supply of water, which is conducted by artificial channels from elevated springs, or from the upper courses of streams. The rice fields of the plain of Bangka, ten or twelve miles inland, are chiefly supplied by a stream which is conducted from a higher part of the Tamsuy River, and is carried across another stream at Kiang-beh, by a wooden aqueduct of 100 yards or more in length. Two harvests in each year are obtained from the irrigated fields. In November or December, after the removal of the autumn crop, the fields are ploughed up. The fields remain vacant for about four months, save that about the end of January seed is grown in nursery patches sheltered from the north-east. In February or March, the fields are in course of preparation for planting. Besides the plough, two kinds of harrows are used, namely (1) the "blade harrow" (locally called "Kiva-pay"), a wooden frame, holding beneath it two sets of metallic blades, which make parallel cuts through the clods or mud as the implement is drawn along by a buffalo, the driver standing on the frame; (2) the "hand harrow" (or "Chew-pay"), of iron, with a long row of spikes. This seems to complete the stirring of the ground. In the latter part of March, or the early and middle part of April, the fields, now in a state of soft mud, are planted out with the young rice plants. In taking up the strong plants from the nursery patches, a sort of flat spatula is passed underneath, so as to take off a very thin slice of earth with the plants upon it.

In the immediate neighbourhood of Tamsuy, about a fortnight before the harvest, the rice is laid down, four adjacent rows being folded together, and so laid that the ears of each cross-row shall

rest upon the cross-row in front of it. It does not appear that this practice is followed in the more sheltered inland country. In July the crop is reaped. The grain is thrashed out immediately in the fields. There is a tub, within which is placed obliquely a set of wooden bars. The operator takes by the lower end a handful of rice stalks, and gives it a few smart blows upon the bars, detaching the grain, which is received in the tub. A curtain, supported by bamboo sticks, keeps the grain from flying overboard. The tub is dragged forward as the progress of the work requires. The ground is then speedily got ready for the planting out of the second crop, the young plants of which are already growing upon nursery patches. In preparing the fields for the second crop, the implement chiefly used in the locality is the "lah-tak." This is a wooden roller, 4 or 5 feet long, and 12 or 15 inches in diameter, very deeply grooved longitudinally, so that its rectum would be a seven-pointed star, and mounted in a wooden frame, in which the driver stands. The lah-tak is drawn by a buffalo, over or through the wet land, the rollers revolving and stirring the soft surface by the action of its grooves and ridges. The second crop is planted out in the latter part of July or early part of August, and is reaped in or about the first week of November. This completes one year. In some cases the second crop is planted before the reaping of the first crop, the young plants being placed among those of the first crop. The planting out of the first crop in the spring, and the harvesting of the second crop in late autumn, are liable to interference from the chill blasts and driving rain of the north-east monsoon. The frequent prevalence of wet weather in winter is a well-known peculiarity of this region. In summer there is sometimes an unfavourable continuance of dry weather. In the plain of Bangka, and in the regions to the south, the seasons are somewhat earlier, and there seems to be some difference in the mode of procedure. The dry ground rice, grown without irrigation, locally called "e-neap," or "i-liap," may be seen occasionally inland, and it is said to be cultivated by the wild aborigines of the mountains. It appears to be very fine rice, but to yield only one crop a year, and not to succeed well if the weather be dry. There are flour-mills worked by the overshot water-wheel. The wind-mill, which might be very useful in China, seems to be unknown to the Chinese, as it was to the ancient civilized nations of the west.

A simple contrivance, called the "water-hammer," or "water-pestle," is used for the pounding, to clean away the integument of the rice. The pestle is fixed like a hammer-head in the end of a beam which moves on an axis. The other end of the beam holds a bowl or shallow bucket, into which falls a small stream of water. When the bucket is full, its weight and the impulse of the falling stream send it downward, raising the pestle; but in sinking it pours out its contents and passes out of the course of the stream. The pestle then falls, bringing the bucket under the stream again, and so the process repeats itself.

Japan.—The surface of the paddy fields in Japan is estimated at

about 4,000,000 acres; the annual yield is said to amount to 50,512,000 hectolitres, of a total value of £6,500,000 sterling.

The young rice plants are set out in the paddy fields in regular rows of bunches towards the end of May or the beginning of June, having been previously raised in some different place. The harvest takes place in September or October. Japan exported in 1884, 1,137,059 piculs of rice, or double the exports of 1882.

Rice-wine, or saké, as it is locally called, forms the principal and almost the only alcoholic beverage of Japan. It is made exclusively of rice. In preparing the ferment the rice is washed, steamed during several hours, and spread out on mats to lower the temperature; afterwards it is kept in a warm room for several days, where it is mixed with a certain quantity of rice covered with fungi; these latter spread rapidly over the whole surface of the rice. The fermenting wort is made of fresh rice, also steamed, and mixed with water and a certain percentage of ferment in small tubs. A large cooler is filled with these mixtures, and kept for about eight days at a certain temperature, which is maintained by introducing a vessel filled with hot water into it. The wort first gets a sour taste, whereupon the temperature is lowered; at a later period the taste becomes bitter, and the wort is cooled so as to stop further fermentation. In January the real brewing begins. Again fresh rice is steamed, washed with a considerable percentage of both the ferment and the wort, mixed with a sufficient quantity of water. The whole is then transferred into big vats, frequently stirred, and left for about twenty days, at the expiration of which period it usually acquires a vinous taste. The mash is now placed in bags and pressed, and the liquid runs out into casks, where it settles, whence it is tapped when quite clear. The clear liquid is then heated up to a certain point and kept in large butts. This saké is generally drank hot at meals. The residues and the spoiled saké are distilled, and the alcoholic liquid used for making the "mirin" or sweet liquor. The total production of saké is estimated at 150 million gallons.

Java.—There are three principal varieties of rice reckoned here: *Oryza glutinosa*, or Ketan; *Oryza sativa*, or paddy; and sawa (*Oryza montana*), with a variety called Paddy Girek. This last sort falls from the stem immediately after being cut. Besides these principal kinds, there are more than one hundred varieties, some of which are cultivated in upland grounds, but the greater part in irrigated lands.

The mean temperature varies very little in Java in the various regions, even at different elevations. Rice grows as well at heights 3500 feet above the level of the sea, where at six in the morning, before sunrise, the thermometer only marks 10° Réaum., while in the day it will ascend to 20°. The stalks are, however, less heavy and the grain ripens quicker than in the interior, where it will not ripen under eight months.

The yield cannot well be fixed, for this depends upon the kind of rice and the nature of the soil. A return of 80 to 100 for one is considered very good, although this is sometimes exceeded.

The time of sowing and transplanting varies, depending upon the nature of the rains, as the sowing commences in the wet season. The culture of rice is the principal occupation of the people, as it is not only the chief source of their food, but there is a surplus for export.

The table rice is called *Beras*; the glutinous rice is employed for making pastry; the red rice is given to poultry and horses; the black rice is more remarkable for its colour than for its quality. In Java, as in Sumatra, there are two different climates, one in the lower regions, which are tropical, and those of the higher plains and mountains, which resemble the climate of Southern Europe.

The other islands of the Archipelago present a variable climate, tempered by the vicinity to the sea.

Java suffers much in competition with the other producing countries, such as Siam, British India, China, and Japan, the price of rice having declined one-half.

Borneo.—Both the soil and climate are here very favourable to the growth of rice, but little more is grown at present than would appear to suffice for home consumption. It is raised in almost every part of the country.

In the *Philippines* the hill rice is sown in May, and cut in October; whilst that of the plains is planted generally in July or August, and gathered in December and January. Rice forms the staple article of food for the inhabitants. Its price varies according to locality.

One *quinon* (or about 7 acres of land) in the province of Bulacan, is said to produce on the average 250 to 300 *cavans* (96 lbs. each) of paddy. Were the system of irrigation understood and generally practised, the cultivation of rice might be considerably augmented.

Africa.—The cultivation of rice undoubtedly dates from the oldest periods of which we have any historical record. "Cast thy bread upon the waters: for thou shalt find it after many days,"* evidently applies to rice, which in Egypt is always sown whilst the waters of the Nile still cover the land, the retreating floods leaving a rich deposit of thick alluvial silt, in which the rice vegetates luxuriantly.

The chief rice grounds of Egypt are in the Delta, and the choicest in the environs of Damietta. The beating and husking are effected with American machines. The commerce in rice centres almost exclusively at Alexandria, Damietta, and Rosetta.

Rice is cultivated abundantly by the negro tribes of East Africa to the Monomoisy inclusive, bearing everywhere its Malay name of "*padi*." Cademosta met with rice on the Gambia. And Lopes (A.D. 1588) speaks of "a grain brought to Congo not long since from the river Nilus, and called '*luco*,'" in which word we readily recognise the Egyptian name of rice. It is also grown on the west coast of Africa, and in the islands of Ceylon, Réunion, Mauritius, and Madagascar.

* Ecclesiastes xi. 1.

Brazil.—Vast plains and even slopes of hills favour throughout this empire the culture of rice, which sometimes grows to 3 feet in height, and produces more grain than the fertile lands of India. Maranham rice rivals that of Carolina, and on the marshes and banks of the rivers of Mato Grosso, or those of San Francisco and others, it grows and yields excellent crops without labour.

Wallace, in his 'Travels on the Amazon,' thus describes the process by which the rice is freed from its husk at Para:—"The grain first passes between two mill-stones, not cut, as for grinding flour, but worked flat, and by this the outer husk is rubbed off. It is then conveyed between two boards of similar size and shape to the stones, set all over with stiff iron wires about $\frac{3}{8}$ of an inch long, so close together that a grain of rice can just be pushed in between them. The two boards very nearly touch another, so that the rice is forced through the spaces of the wires, which rub off the rest of the husk and polish the grain. A quantity, however, is broken by this operation, so it is next shaken through sifters of different degrees of fineness, which separate the dust from the broken rice. The whole rice is then fanned to blow off the remaining dust, and finally passes between rubbers covered with sheep-skin with the wool on, which clean it thoroughly, and render it fit for the market. The Para rice is remarkably fine, being equal in quality to that of Carolina, but, owing to the carelessness with which it is cultivated, it seldom shows so good a sample. No care is taken in choosing seed or in preparing the ground, and in harvesting a portion is cut green because there are not hands enough to get it in quickly when it is ripe, and rice is a grain which rapidly falls out of the ear and is wasted. It is therefore seldom cultivated on a large scale, the greater portion being the produce of Indians and small landholders, who bring it to the mills to sell."

United States.—Rice was first introduced into Virginia in the year 1547. In 1698 about 60 tons were shipped from Charleston to England. In 1718 its cultivation was commenced in Louisiana by the "Company of the West." The swamps of South Carolina have proved well suited for the production of rice; and not only has the cultivation been effected with trifling labour, but the grain produced possesses a remarkably fine quality, being decidedly larger and handsomer than that of the countries whence the seed was originally derived.

In 1840 the rice crop of the United States amounted to 80,841,422 lbs.; that of 1850 to 215,312,710 lbs., and that of 1860 to 187,140,173 lbs. The production of 1870 was but 73,600,000 lbs. The countries south of the United States, viz. Cuba, Porto Rico, and the West Indian Islands, Mexico, Venezuela, and other Central and South American States, are the largest consumers of rice in the world, with the exception of China. These countries, instead of seeking their supplies from the United States, now draw them mostly from England, and all because the rice cannot be cleaned and dressed in the United States. The duty on raw rice drives it to Liverpool to be cleaned.

The rice crop of Louisiana is an industry of increasing im-

portance, and particularly so from the fact that its cultivation exacts the investment of but a limited amount of capital. When fields are once divided by ditches, and a substantial culvert and sluice gate, to admit the water from the river, are constructed, every preparation for commencing the cultivation of this product has been made. The entire cost for preparing the land and for seed is estimated at $3\frac{1}{2}$ dollars per acre. Its cultivation and shocking amount to 13 dollars more, and the expenditure, 6 dollars, for thrashing and handling, sums up 22 dollars for twelve barrels of rough rice, which can be produced on one acre. Milling, freight, package, insurance, drayage, and commission will amount to 3 dollars 40 cents more, making a total expenditure of 36 dollars 40 cents for 1200 lbs. of clean rice, worth 84 dollars. It will be seen that a net profit of 47 dollars 60 cents per acre is thus given, making allowance for the wages of labourers and every other expense. Ploughing for rice entails scarcely any labour, the earth being turned up but for a few inches. The same is true of cultivation, the occasional flooding of the land being the chief requisite. Only during the harvest season is a large force required, and the adoption of the newly-invented labour-saving machines would materially reduce the estimated cost. Upland rice is an important crop not only for home use, but pays well for its cultivation, and should be more generally looked after than it is.

Sandy land, level and fertilized, is best for upland rice. Land that will yield 25 or 30 bushels of corn per acre will produce 50 bushels of rough grain, that will, when hulled, leave 25 bushels of clean rice, say 1,200 lbs., that, at 5*d.* a lb., would be worth £24, and the straw is worth one-third more.

THE MILLETS, OR SMALL-SEEDED FOOD-GRAINS.

The word millet has a widely extended signification, and embraces the edible seeds of various grasses, very dissimilar in habit and appearance. In popular parlance the term is applied to almost all the small-seeded edible grains. In many countries different millets form large and important food-crops, and in some years considerable quantities have been imported into the United Kingdom. In 1870, we received 74,635 cwts. of millet, valued at £19,864, and 70,735 cwts. of Dhurra, valued at £19,491; since then these grains are not particularised in the imports.

In England the millets are very seldom eaten as food, and yet among the great variety of seed in this extensive group of plants (of which we as yet know comparatively little in an economic point of view) many form articles of large consumption in parts of Europe, Asia, Africa, and the West Indies. They pass under a variety of names in different localities; in Northern Africa the large-seeded species is known as Dhurra, and this occasionally reaches Mark Lane to be ground and mixed with flour. In the West India Islands it is known as Guinea corn, in India as Jowarrie,

in Southern Africa as Kaffir corn, in the United States as broom corn, and so on.

Of these small food-grains Roxburgh remarks: "It is probable that through the whole of Southern Asia as many of the inhabitants live on the various kinds of dry or small grain as upon rice, and they are reckoned fully as wholesome as that is."

Dr. Forbes Watson, in his treatise 'On the Composition and Relative Value of the Food Grains of India,' also states that the millets in India occupy a position second to none in the country, and form the staple food of a larger number of the population than perhaps all the other cereals put together.

A third part of the inhabitants of the globe feed upon the different millets, especially those of Africa, the greater part of Turkey, Persia, and India. In Japan about 35,000,000 bushels of various kinds of millet are raised annually. Millet forms the principal sustenance of the people of Bokhara. The grain there yields so abundant a harvest that there is a large quantity for export. The seeds of millet are excellent for food both for domestic animals and man. The grain mixed with that of wheat gives an excellent bread, though a little heavy; but generally it is boiled with milk, like maize meal; it swells considerably in water. Millet fattens poultry in a very short time. The stalks serve for heating ovens or for cooking food in countries where fuel is scarce. The panicles of some, after the separation of the grain, form excellent brooms; the sale of these brooms in Italy, in Spain, France, and North America, is so remunerative that they enter largely into the value of the profits of culture.

Millet is considered in Texas one of the very best substances for feeding horses, oxen, milch cows, and sheep during the winter months. The yield is very heavy; so productive has it been found that in many regions of the State it nearly supersedes the use of fodder.

The two genera *Andropogon* and *Sorghum* are closely allied. Some of the best authorities consider the difference so slight as to warrant their union into one.

The species are very imperfectly understood, and as yet badly described. Professor Parlatore, in a collection shown at the London Exhibition in 1862, enumerated the following species of *Sorghum*:—

<i>Sorghum compactum</i> .	<i>Sorghum saccharatum</i> , Moench.
" <i>durra</i> .	" <i>caffrarum</i> , Beauv.
" <i>nigerricum</i> .	" <i>cernuum (album)</i> , Willd.
" <i>nigrum (S. vulgare)</i> .	" <i>elongatum</i> , Beauv.
" <i>vulgare</i> (three varieties).	" <i>glycychilum</i> .

The specific limits of the various *Sorghums* are not well ascertained. They are, however, much cultivated in different parts of Africa, in the West Indies, and various districts of North America and India, and have been introduced into Australia.

The large INDIAN MILLET OR GUINEA CORN (*Andropogon Sorghum*, Brotero; *Sorghum vulgare*, Persoon; *Holcus Sorghum*, Lin.), is grown

in the warmer parts of Asia, and is very prolific; the grain can be converted into bread, porridge, and other preparations of food; it is the yellow cholum and jowarrie of some districts of India. This is a beautiful grass, resembling in appearance Indian corn. It bears a small yellow seed, which when crushed makes a good auxiliary food for cattle or sheep. It grows on all kinds of cultivated soil, but best on those that are thoroughly cultivated and well manured. Indeed, few crops will pay better for high cultivation. This valuable plant has attracted a great deal of attention during the last few years, and has been highly recommended as a fodder crop. It is best suited for cultivation in countries where the temperature seldom falls below 60°. It will certainly grow in much colder climates, but scarcely pays expenses. This forms with rice the staple food of the Madras Presidency, with rice and bajree that of the Bombay Presidency, and with wheat that of the North-West Provinces, Oudh, Punjab, and the Central Provinces.

This millet may be said to be the chief dry grain crop of India, although in some parts of the South Raggy (*Eleusine corocana*) is now commonly cultivated. It is very nutritious, and contains about 9 per cent. of nitrogenous matter, and 70 of starch. It is cultivated at Chevesso and Turin for the sugar obtained from the stem. This product is noticed in the description of "Sugar," p. 218.

This hardy species of millet (*Sorghum*), known as Kaffir corn, is raised in great abundance in all parts of the colony of Natal by the natives, for food, and the manufacture of their native beer. Were its uses for distillation known, a larger demand ought to be created for this easily grown corn.

This grain is universally cultivated, and is in fact in some parts the principal support of man and beast. It will grow upon most soils, but luxuriates in the black soil. There are several varieties, but principally one with red seeds and one with white. Some botanists recognize at least three species in cultivation, more or less extensively, in India—*S. vulgare*, Pers.; *S. cernuum*, Willd.; and *S. bicolor*, Moench; whilst others regard them as mere varieties of the one species, which is extensively grown over the world, and exhibits, like all largely cultivated plants, a great tendency to variation.

Dr. J. F. Watson gives the composition of this seed as follows:—

	Per cent.
Water	11.95
Nitrogenous substances	8.64
Dextrine	3.82
Sugar	1.46
Fat	3.90
Starch	70.23*

* With husks.

From an analysis of the half-grown plant raised in England, Dr. Voelcker found that it contained about 2½ per cent. of flesh-

forming matters, and about 11 per cent. of fat, or heat-producing matters. The composition was:—

	Per cent.
Water	85·17
Flesh-forming matters	2·55
Fat or heat-producing matters	11·14
Inorganic matters	1·14
Total	100·00

There was little or no sugar in the half-grown plant, but when three-quarters grown, there was as much as 5·85 per cent. of sugar in the lower part of the stem. We have no analysis of Indian-grown plants; but it may be safely inferred, that if such a large amount of sugar was present in plants grown in a climate so ill suited for the production of sugar as England, a very much larger quantity would be found in plants grown in the tropics.

Among the food-grains grown in the Madras Presidency, there were in 1870 devoted to—

	Acres.
Cholum (<i>Sorghum vulgare</i>)	4,855,000
Raggy (<i>Eleusine corocana</i>)	1,611,000
Veragu (<i>Panicum miliaceum</i>)	1,605,000
Cumboo (<i>Penicillaria spicata</i>)	3,197,000
Corralu (<i>Panicum italicum</i>)	1,018,000
Millet of various kinds	614,000
Total	12,900,000

From experiments carried on in India with plants as fodder-producers, the following were found to be the results:—

	Weight of Fodder per Acre.	Days required to produce a Crop.
	lbs.	
Yellow Cholum, dry crop	10,000	90
„ wet „	12,000	60
Chinese cane (<i>Sorghum saccharatum</i>) } dry crop	20,000	80
Cumboo, dry crop	15,000	75

In Ceylon there are about 72,762 acres under these small grains.

In India where rice is not cultivated as the staple food, the millets are exceedingly important. There are under culture with other food grains (including pulses) 71,795,000 acres.

RED CHOLUM.—This is the *S. (Andropogon) Caffrarum*, Kunth, of the Australians; it is a variety of the white cholum, and is supposed to have been originally obtained from the south-eastern coast of Africa. In America it is by many considered a better sugar-producer than the Chinese species, and all agree that its sugar is much more easy to analyse.

S. cernuum, Willd., *Andropogon cernuus*, Roxb., of which the grain is white, forms the staff of life of the mountaineers beyond Bengal. It is much cultivated in India and other tropical countries.

SORGHUM or DHURRA is produced in considerable quantities in middle and lower Egypt for making bread. Being 40 or 50 per cent. cheaper in price than wheat, it is more commonly the food of the fellah or peasant than any other grain. The late Professor Johnston states that from his analysis Dhurra flour contains $11\frac{1}{2}$ per cent. of gluten.

Schweinfurth tells us that a large yellow-grained variety of *S. vulgare* is known in the Khartoum markets as Soffra. The panicles are about nine inches long and four in diameter. In Algeria two species are grown, the *Sorghum scoparium*, Lin., with a red grain; and the *S. vulgare*, Lin., with a white grain. It is sown in April, in good deep soil, when not irrigated, or in June, when water can be had. These plants are, however, remarkable for their resistance to drought and their power of vegetation.

The grain of the *S. vulgare* has a high food value both for man and animals. The Arabs merely cut off the panicles, and leave the green stalks standing, to feed their cattle. The grain is known in North Africa under the names of bechna, dari, and durra.

The dari from Jaffa is considered the best in the Mediterranean, on account of its whiteness and hardness. It used to be a large article of export from thence to the United Kingdom for feeding and distilling purposes. Dari is used by the poorer classes there for making bread.

In 1870 the land under culture in Natal with this Sorghum and the produce were as follows:—

—				Acres.	Muids.
By natives	..	..	..	45,047	172,077
„ Europeans	..	..	..	50	334

The muid is nearly three bushels. There were also forty-eight acres under other millets, which yielded 1091 cwts. of grain. In 1875 the land under millets was only 36,162 acres.

Sorghum (Andropogon) saccharatum. This plant can be advantageously utilized for preparing treacle. For this purpose the sap is expressed at the time of flowering and simply evaporated; the yield is from 100 to 300 gallons from the acre.

This sugar-producing millet has been already alluded to at p. 218.

BROOM CORN or MILLET (*Sorghum Dhurra*).—Whether this is only a variety of *Sorghum vulgare*, the *Holcus Dhurra*, Forsk., or a distinct species, it is impossible to state. Its seed-panicle is, how-

ever, loose and spreading instead of close and compact, like the principal kinds of *Sorghum vulgare*. One species of *Sorghum*, described as *Sorghum Dhurra*, is grown in Italy, in the United States, Australia, and other countries, chiefly for its panicles as a brush-making fibre.

There are many thousand acres under culture with it in the United States. The following is the mode of culture pursued in America :—

The seed is sown with a seed-harrow or drill, as early in spring as the state of the ground will admit, in rows $3\frac{1}{2}$ feet apart. As soon as the corn is above ground it is hoed, and soon after thinned, so as to leave the stalks 2 or 3 inches apart. It is only hoed in the row, in order to get out the weeds that are close to the plants, the remaining space being left for the harrow and cultivator, which are run in frequently so as to keep down the weeds. The cultivation is finished by running a small, double mould-board plough, rather shallow, between the rows.

The broom corn is not left to ripen, but is cut while it is quite green, and the seed not much past the milk stage. It was formerly the practice to lop down the tops of the corn, and let it hang some time, that the brush might become straightened in one direction. Now the tops are not lopped till the brush is ready to cut. A set of hands goes forward and lops or bends the tops to one side, and another set follows immediately and cuts off the tops at the place at which they are bent, and a third set gather the cut tops into carts or waggons, which take them to the factory. Here they are first sorted over, and parcelled out into small bunches, each bunch being made up into brush fibre of equal length. The seed is then taken off by an apparatus, with teeth like a hatchel. The machine is worked by six horses, and cleans the brush very rapidly. It is then spread thin to dry, on racks put up in buildings designed for the purpose. In about a week, with ordinary weather, it becomes so dry that it will bear to be packed closely.

Carpet brooms, velvet brushes, and other kinds of brushes are made of the panicles. In Victoria broom corn and millet valued at £7000 are imported.

PANICUMS.—*Panicum* is the richest in species among the grasses. At present about three hundred well-defined species are known, chiefly tropical and sub-tropical. Many are good fodder plants, whilst the seeds of several furnish palatable and nutritious table food.

In Algeria the following are grown :—*P. glomeratum rubrum*; ordinary millet (*P. miliaceum*); the brown Pekin (*P. Pekinensis*); the Persian millet (*P. Persicum*); another with a large spike (*P. monostachyum*, H. B.); bristling millet (*P. echinatum*); *P. eriogonum*; and the Hungarian millet (*P. Germanicum* or *Italicum*).

ITALIAN MILLET (*Panicum Italicum*; *Setaria Italica*).—There are three varieties of Italian millet. This grain is cultivated in many parts of India, and delights in a light, elevated, tolerably dry soil. It is much prized by the native Indians of all descriptions, who

make cakes of it, and also a kind of porridge; for the purposes of pastry it is little if at all inferior to wheat, and when boiled with milk forms a light and pleasant meal for invalids. The Brahmins hold it in high estimation, indeed more than any other grain. The seed-time for the first crop is June or July, and the harvest in September. A second crop may be had from the same ground between September and the end of January. This plant is commonly cultivated in the Himalayas, occasionally up to 6500 feet. It is grown as a dry crop, but not to any large extent. It forms a light and easily digested article of food.

CHENA OR INDIAN MILLET; VERAGOO (*Panicum miliaceum*, Lin.).—This does not appear to be a crop worth much attention. The grain is very inferior, and fetches a low price in the bazaars of India, while it is a very slow grower, and occupies the land a long time. Still it is extensively cultivated in most parts of India. In the Deccan it is sown in June or July by hand, is sometimes transplanted; requires weeding in August and September, and is reaped in November or December. The grain contains about 9 per cent. of nitrogenous matter, and 59 of starch, is considered digestible and nutritious, and in some parts is mostly consumed unground.

It is grown in Sicily, where it is called milium, or little millet, and there are two well-known varieties, one with brown seed, and the other yellow-coloured.

SHAMAY.—In Bengal *Panicum miliare*, Lam., is the species usually known as little millet. It would seem to be a native of India and China, and is by no means extensively cultivated. In the Punjab it is known as *kutki*. In South India it is pretty generally used as an article of food.

Panicum colonum, Lin.; *Oplismenus colonus*, Beauv.—This small grain millet, which grows wild in parts of India in sufficient plenty, is collected in times of scarcity to be employed as food.

SAWA MILLET (*Oplismenus frumentaceus*, Kunth.; *Panicum frumentaceum*, Roxb.).—This plant is much less cultivated in India than *P. miliaceum*. It delights in a light, tolerably dryish soil; the same ground, according to Dr. Roxburgh, yields two crops between the first of the rains in June and July and the end of January. The seed is wholesome and nourishing; it is an article of diet amongst the lower classes of the natives, and yields about fifty-fold in a good soil. The seed is light and easy of digestion; it makes very palatable puddings, which children appear more partial to than those made of rice, to which grain, when boiled, it bears a striking resemblance, both in taste and appearance.

CUMBOO OR SPIKED MILLET (*Penicillaria spicata*, Swartz.; *Pennisetum typhoideum*, Rich.; *Holcus spicatus*, Lin.; *Panicum spicatum*, Roxb.).—Terminal cylindric spike erect, as thick as a man's thumb, from six to nine inches long; seed obovate, pearl-coloured,

smooth, with hilum. It is cultivated almost in all parts of India, except Eastern Bengal, and used by the poorer classes in Behar, the North-West Provinces, and Punjab.

This plant yields about 668 lbs. of seed and 3 tons of straw per acre. In some localities the grain is called bajra or bajree, and, with the usual adjuncts of a little milk, &c., forms the chief article of diet of a very large number.

Compared with rice it is considerably more nutritious, containing about $10\frac{1}{2}$ per cent. of gluten, and giving a proportion between the carbonaceous and nitrogenous compounds of from 7 to $7\frac{1}{2}$ per cent. of the former to one of the latter; whereas the kind of rice most rich in gluten contains only about $8\frac{1}{2}$ per cent. of that substance, and gives the proportion of a little more than 9 of the non-nitrogenous to the nitrogenous, thus involving the addition of a large quantity of some pulse or extra nitrogenous substance to maize—the proportion between the flesh-forming and heat and fat-yielding constituents. It is this grain which is chiefly used for the Couscoussou of Northern Africa. The seed may be planted in the close of April; in September or October the seed-spikes ripen; the stalks, chopped, are fed to cattle. With the decorticated pith of the stalk a pleasant beer can be made by the addition of hops.

This grain is, from the shape of its seed-spikes, called candle millet. It is the "benitche" of the Arabs of Africa. The spiked millet is as common in Africa as in Asia, at a distance bearing some resemblance to our indigenous cat's-tail grass, or Timothy, in the form and size of its spikes. Many stems often proceed from the same root, and these are from three to six feet in height. The fruit-spike is dense, compact, and thicker than a man's thumb, from six to nine inches in length in India, or twice as long as it grows in Africa. Except Sorghum, this is the most commonly cultivated grain in India.

Roxburgh says that it is sown about the beginning of the rains, that is about the end of June or beginning of July, and is ripe in September. It is much cultivated in the higher lands on the coast of Coromandel. The soil it likes is one that is loose and rich; in such it yields upwards of a hundred-fold; the same ground will yield a second crop of this or some other sort of dry grain during October, November, December, and January.

The stalk is almost useless as fodder when dry, but cattle are sometimes fed with it when green. The seeds are rather heating, and are used in cold weather mostly as flour. In Africa a kind of beer is said to be made from the malted grain.

The percentage composition of the grain is:—

Water	11.80
Nitrogenous substances	10.13
Fat	4.63
Water	71.75

RAGGY, OR RAGGEE (*Eleusine corocana*, Gaert.).—This grain is of high importance to the poor of India, from its hardiness and from

the abundant return it gives. It will grow on almost any soil, but the yield will be proportioned to the quality of the soil and to the attention bestowed on the cultivation. The seeds are usually ground into flour by the hand-mill, this being chiefly a bread-grain. In the south it is very largely cultivated, and extends north over the Punjab plains to the Himalaya, where it is frequently found as far west as the Chenab, up to 6000 and 7000 feet. This grain is the chief article of food amongst the poor and labouring classes in Mysore and other parts of Southern India, and is very nutritious; coolies and others performing hard outdoor work prefer it to every other sort of grain. It is usually stored in pits, and will keep good in them for many years. *Eleusine stricta* is said to be the most cultivated species of the two, as it is found to be the most productive.

KODA MILLET (*Paspalum scrobiculatum*, Lin.).—This is a common and cheap grain, grown to some extent in most parts of India. It delights in a dry and loose soil. The seed is an article of diet with the Hindoos, particularly those who inhabit the mountains and most barren parts of the country, for it is in such districts it is chiefly cultivated, being an unprofitable crop, and not sown where others more beneficial will thrive.

Another undescribed species, believed to be *P. exale*, is grown in Sierra Leone and other places on the West African coast, where it is known under the names of hungry rice and fundungi.

TEFF (*Poa Abyssinica*, Jacq.; *Eragrostis Abyssinica*, Link.).—There are several varieties of this millet; though the seed is small, it is abundant, and much used by the natives of the Soudan; and also forms the bread-corn of Abyssinia.

STARCH-PRODUCING PLANTS.

Starch is the chemical and common name, in some instances, for the fecula or amylaceous matter washed out from different parts of several plants, such as the seeds, roots, and cellular tissue of the stems. It is one of the most abundantly diffused of all proximate vegetable principles.

Some kinds of starch are prepared for application in the arts, and by the laundress for stiffening linen; others are more powdery, and are used for food, such as the arrowroots and corn flours; others again are granulated like the sagos and tapiocas.

The colour of starch is usually pure white; in some cases a tinge of blue can also be seen, as in some wheat starch, while that from the potato has a slightly yellowish cast. The fineness of the starch powder depends on the size of the individual grains, except where the grains are artificially agglomerated, as in sago and tapioca; the former is in small, round, white or brownish grains, while tapioca is in larger, irregular, white fragments. The individual starch grains vary much in size, though they are pretty

constant in any given species. Oat, rice, and rye starches represent the smallest grains, while those of maize starch are much larger. The medium size is found in the grains of wheat and arrowroot starch; the largest grains are found in potato and Canna starch. In the last two the unaided eye can distinguish the largest individual grains, but in nearly all others they can be seen only under the microscope. The specific gravity is more than that of water, though it varies much with the state of dryness of the starch. Its average is given by Wiesner at 1.5; it, however, varies with the different species of starch. The grains contain considerable water—as high as 30 per cent. when fresh, reduced sometimes to 7 per cent. when air-dry.

Under the microscope the starch grains present the form of minute grains of a form and structure characteristic for each species.

They are for the most part bounded by curved surfaces—spherical, elliptical, egg-shaped, bent-shaped, &c.—but sometimes have flat surfaces as well. They usually contain a dark spot, line, or cross within, which is sometimes central, sometimes eccentric. This spot is called the nucleus, and is generally small and round in starch found in fresh tissues, slit or cross-shaped in grains which have been dried.

Arrowroot and starches are not now individually named in the Board of Trade returns, but are included under the head of “Farinaceous substances and manufactures therefrom.” The value of the imports in 1886 was £809,855, of which £562,526 came from foreign countries. The following may be taken to have been potato starch:—Germany, £364,625; Holland, Belgium, France, and Austria, £107,360; Italy, £43,871 (probably macaroni); Brazil, £3505, (cassava); United States, £26,918 (starch and corn meal). From the British West Indian Islands £44,990 was doubtless arrowroot, and also £9397 from South Africa, and £2632 from Bermuda; £183,654 from British India was chiefly sago.

ARROWROOT.—The demand for colonial arrowroots has not progressed, owing, probably, to the imitation potato starch, and the corn and rice flours or starches so largely sold.

In 1860 arrowroot to the value of £42,404 was imported into the United Kingdom; in 1870 this had dropped to £33,063, but in 1875 recovered to £56,143. In 1876 the imports into London were larger, amounting to 16,673 casks and 9102 boxes and tins. The imports now are about to the value of £54,000.

Bermuda.—The arrowroot from this island has always been considered the finest and the best quality made, its superiority arising either from the nature of the water or soil, or from greater care in the manufacture. In 1851 arrowroot to the value of £10,334 was shipped; this gradually declined to £3000 or £4000 in 1866, and now the culture has been almost abandoned and given way to more profitable crops.

In Bermuda arrowroot is planted in May, and is ripe in March and April; the time for manufacturing is in April and May, when

the cold winds set in, ranging from north-west to east. The whole process is done in water; the root is grated or torn into a pulp, this is strained through three different sieves, each one finer than the other, left to settle in the bottom of the tubs, then collected into one tub, and passed through the fine sieve into clean water. When settled the brown starch is taken off the top of the white. This brown starch is much more astringent and efficacious in bowel complaints than the white, and is locally preferred. The arrowroot is then passed through more clean water and a fine sieve for the last time, and settles in the tub. It is taken out, placed on cloths to harden, and then broken up fine on trays, and dried in the wind and sun. Four barrels of peeled and cleaned roots will yield in good seasons about 100 lbs. of good arrowroot, and will take from five to six puncheons of clear seft or tank water; it will be about twenty-four hours in the water from the time of grinding till it is upon the cloths or drainers.

Jamaica.—The quantity of land under culture with arrowroot varies. In 1869 there were $65\frac{1}{2}$ acres; in 1881 it had dropped to 25 acres. The exports in 1866 were 70,204 lbs., since then they have been as follows:—

			Lbs.				Lbs.
1872	..	..	13,328	|	1885-86	..	1,000
1879-80	..	..	4,480	|	1886-87	..	1,693
1884-85	..	..	1,008	|			

When made by the labourers in the West Indies on a small scale, arrowroot is prepared much in the same manner as potato starch in this country for domestic use. The only implements required are a grater and wooden troughs and trays; when made on a larger scale, as on the estates of proprietors, the crushing of the root and the reducing it to a pulp are effected by simple and cheap machinery (a wheel and rollers) worked by water. The arrowroot is dried under sheds. Little or no use is at present made of the pulp after the extraction of the starch by lixiviation, but probably a serviceable paper might be made of it at a trifling cost.

In *St. Kitts* arrowroot and tous-les-mois are produced to some small extent.

St. Vincent.—The amount of arrowroot exported from this island is now about 2,000,000 lbs.

Many circumstances have promoted this increased culture. When it began, the price of the article was high, and the grower obtained a largely remunerative profit; its culture was not laborious; it was subject to few risks; it did not for its success require rich land or much manure; there was a constant and increasing demand for it; and, in consequence of the abundance of pure water, great facilities were afforded for the manufacture, and that by a process so simple, easy, and cheap as to require little skill in conducting it, and scarcely any capital.

St. Vincent is the only arrowroot-producing colony that has kept steadily progressive. There will necessarily be slight fluctuations in the out-turn, according to season, &c.

On many parts of the West African coast arrowroot is grown and prepared. The Canary Islands, Liberia, Lagos, Sierra Leone, and other districts produce it, but not in any quantity for shipment.

Natal.—The cultivation and manufacture of arrowroot has been very largely carried on in Natal for many years. It was a great favourite with early colonists, because it grows readily on coast lands unsuited for sugar and coffee. Its cultivation requires only a moderate capital, and yields quick and good returns. The root may be grown many years in succession in the same ground.

The land to be planted is well ploughed and broken up at the commencement of the rains; old ground is better than new. The sets are taken from old stools, planted thickly in a simple plough furrow, and covered over with earth turned out of a parallel furrow.

A sort of nursery is formed in this way: In October and November the shoots are planted out in holes made about twelve or fourteen inches apart, the shoot is placed in the hole, set upright and pressed round with earth. Ten men, working methodically in gangs, can plant an acre in a day. The only care needed is to keep the ground between the plants free from weeds by hand hoeing. The soil best adapted for the cultivation should be fairly good, but light; old bush or forest land is generally very excellent; stony and heavy soils are unsuitable, because the tubers are apt to get clogged in it, their growth is stunted, and it is very difficult to dig them up.

The crop is known to be ripe when the leaves fade; at that time the tubers and offsets are densely filled with starch, and ready to be taken from the ground for manufacture. They are dug up and turned over with a fork, while pickers follow and shake off the earth and pick out the bulbs and collect them in a basket; one forker keeps four pickers employed, and one picker can deal with from 250 lbs. to 300 lbs. of tubers in a day.

About ten acres should be cultivated the first year, and by the time the produce is harvested there ought to be twenty acres of ground broken up ready for planting, and calculated to yield a double income in the following years, with a decreasing expenditure.

The manufacture requires care rather than skill, and the crop is less affected by vicissitudes of weather than almost any other that can be produced. The manufactory buildings may be of the simplest description: all that is required being free ventilation and protection from wet. The abundant water-power of the colony affords ready means of working the machinery. A water-wheel of 4 horse-power is sufficient to manufacture from 4 cwts. to 5 cwts. of starch per day; fifteen Kafir labourers suffice for the management of 25 acres of plantation. As a drawback, on the other hand, the market for the starch is very uncertain and apt to be easily overstocked, and the starch itself is so delicate in quality that it is very liable to deteriorate and become damaged, even after it has been packed and shipped. The greatest cleanliness is required in its preparation.

In the process of manufacture the tubers are pressed against a revolving cylinder of rough tin (resembling a nutmeg grater), and the raspings are then subjected to repeated washings; the fibrous refuse rises to the surface and is skimmed away, while the pure starch settles into a white paste, which is dried on calico trays, then broken into lumps and packed in boxes for market.

During the manufacture four hands are needed in the drying-house and three in the grinding-house. The arrowroot should be quite cold and ready to pack on the fifth day. As it readily contracts moisture from the atmosphere, it must not be packed in damp weather, and it should never be forgotten that the starch is apt to deteriorate in taste and colour if kept in proximity to substances that emit a strong odour, such as hides, sugar, or any decomposing organic matter.

The yield of starch is tolerably much the same whether the growing season has been wet or dry. In wet seasons the tuber is large and soft, but its greater size is made up of moisture, pulp, and fibre, and not of starch. About 15 per cent. of starch should be obtained from good bulbs, and this percentage would give one-third of a ton (worth about £13) of starch per acre. The refuse is excellent for manure.

In selecting the land and site of operations, it is obvious that the close neighbourhood of a good stream of water must be secured.

Much less capital is required for the manufacture of arrowroot than for that of any other article of tropical produce. No more is necessary than such as will just provide a residence for the planter, the simple buildings and machinery for the factory, the implements of husbandry, and food and wages for the labourers during the planting, manuring, and manufacture of the crop. One hundred acres of land should be purchased at from £100 to £200. A rude dwelling and outbuildings may be erected for £70 or £80; machinery and manufacturing appliances, £75; implements of husbandry and oxen, £120; wages and food of eight Kafir labourers for a year, £96; cost of living for the planter and his family until the return begins to come in, from £120 to £150. Taken altogether, a handy, industrious, and thrifty man may reckon upon making good his standing with arrowroot, if he starts with a capital of about £600.

Maranta arundinacea is the species grown. In Natal, in 1864, from 226 acres, the quantity obtained was 2,347 cwts. In 1870 there were 386 acres under arrowroot.

The exports in 1883 were 2,053 cwts., worth £3,317.

India.—The *Maranta arundinacea* was introduced into India about 1840 by Mr. Elphinstone, and is now cultivated in many districts, especially in the Madras Presidency. Arrowroot is in extensive use in India, and some is also shipped to Europe.

AUSTRALIAN ARROWROOT.—Attention has of late years been directed to the production of arrowroot in several of the Australian colonies, facilities having been afforded by the culture and distribution of the several plants from the excellent botanic gardens at Melbourne, Sydney, and Brisbane.

Canna Achiras, Gillies, native of Mendoza, is one of the few extra-tropical Cannas eligible for arrowroot cultivation.

C. glauca, Lin., and *C. coccinea*, Aitkin, yield, with some other Cannas, the particular arrowroot called *tous-les-mois*. *C. flaccida*, Roscoe, of Carolina, is probably also available for arrowroot.

C. edulis, Ker, the Adeira of Peru, is one of the hardiest of the arrowroot plants, for seeds, even if many years old, will germinate, and are commonly called Indian shot.

This species has been extensively introduced into Australia, and, according to Baron Mueller, yields an excellent starch at Melbourne, Western Port, Lake Wellington, Ballarat, and other localities, from plants supplied by the Melbourne Botanic Garden.

The gathering of the roots in Australia is effected about April. The plants can be set in ordinary ploughed land. The starch grains, it is well known, are remarkably large.

New South Wales.—*Maranta nobilis* appears to be the species chiefly cultivated for arrowroot in New South Wales.

In 1885 there were 68 acres, which produced 3,070 lbs.

Queensland.—This colony appears to be particularly suited for the cultivation of arrowroot, which is gradually supplanting the imported West Indian product in the Australian market. A very small price, about 3d. per lb., remunerates the grower who manufactures on a large scale. The plants grown are *Maranta arundinacea* and *Canna edulis*. *Manihot utilissima* and *Janipha*, and a Japanese variety of yam, *M. Japonica*, are also cultivated.

The cultivation and manufacture of arrowroot is becoming an important affair in this colony. The export of the article has gone on increasing for the last five or six years. In 1863 it scarcely had an existence; in 1870 the export had reached 30,000 lbs. But the quantity exported is small in comparison with that consumed in the colony; for it is in favour with all classes of the community, and forms an easily digested, but nourishing and most appropriate article of food during their long, hot summer. As the majority of farmers on the coast lands, and not a few of the inland farmers as well, have a patch of roots and a mill and appliances for reducing them, the total quantity of starch made will probably be about 100,000 lbs.

Pacific Isles.—A plant largely cultivated is the *Tacca pinnatifida*, Forster, which is indigenous to the sandy shores of the South Sea Islands, and is known in Oceania, but especially in Tahiti, under the native name of *Pia*. This plant is, however, now widely diffused. It is met with in China and Cochin-China, according to Loureiro, is cultivated in the Moluccas, Arracan, and other parts of India, and at Zanzibar, and is found in large quantities in Cook's Archipelago, the Hervey Islands, at Raiatea, Huahine, Bora-Bora, Maupiti, the Hawaiian Islands, the Samoas, Tonga, the Fiji Islands, &c. The tubercles bear much resemblance to the potato, but, unlike that root, the fecula is found chiefly in the centre and not towards the exterior. The proportion of starch yielded is 30½ per cent.

There is a large consumption of starch in Tahiti, especially for

children and invalids, and a considerable export of it under the name of arrowroot. The principal part of that which enters into commerce is made in the islands of the adjoining archipelago, Raiatea, Huahine, Bora-Bora, and Maupiti.

From it the main supply of the Fiji arrowroot is prepared. The Tacca starch is much valued locally, and particularly esteemed in cases of dysentery and diarrhoea. Its characteristics are readily recognized under the microscope. A Tacca occurring on the Sandwich Islands yields a large quantity of the so-called arrowroot exported from there. Other species, including those of *Ataccia* (*Tacca*) *integrifolia*, Presl., occurs in India, Madagascar, Guinea, and Guiana, all deserving tests in reference to their value as starch plants.

MANIOC, OR CASSAVA.

This is the plant chiefly cultivated for food purposes in Brazil and in many of the West Indian Islands. No species of plants have been more changed in scientific nomenclature by botanists than these, for they have alternately been classed as *Jatrophas*, *Janiphias*, *Manihots*, *Curcas*, &c. I will adopt the names given by Pohl to the two principal species (for most of the others seem to be but mere varieties), the bitter or poisonous species, *Manihot utilisima*, and the sweet species, *M. Aipi*.

The manioc would seem to be a native of Brazil; it has been introduced into India, and is grown about Calcutta, Madras, the Straits Settlements, and other quarters. It flourishes better on the borders of the sea and on islands than in the interior of the continent. On the coast of Coromandel the roots are more fibrous, and, therefore, inferior to those raised in Malabar. It is extensively grown in Guiana, the West Indies, and various parts of Africa.

The starch heated while in a moist state furnishes the tapioca of commerce. Cassava is abundantly cultivated in Brazil and Venezuela—especially at Caraccas, where the singularly uniform temperature throughout the year is only 60° to 70° Fahrenheit. It is a very exhausting crop, and stands in need of rich soil and manuring. The propagation is effected by cuttings from the ligneous part of the stem.

The soil destined for manioc must not be wet. In warm countries the tubers are available in about eight months, though they still continue to grow afterwards. The growth of the plant upwards is checked by breaking off the buds. The bitter species is the more productive of the two. The yellowish tubers attain sometimes a weight of 30 lbs. They do not become soft by boiling, like the Aipi or sweet manioc.

The sweet species, though a native of tropical South America, extends as far south as the Parana river. The root is reddish and harmless, and can be used, unlike the bitter species, without any further preparation than boiling as a culinary esculent, irrespective of its starch being also available for tapioca.

Through the root of the sweet tapioca there runs a tough ligneous fibre, not found in the bitter, which is one mode of distinguishing them.

The bitter tapioca, both as a vegetable and in the form of cassava bread, forms one of the staple foods of the many races. It is easily propagated by joints of the stem buried in the ground, and these give a return in good stuff, equal to about £5 to £8 per acre.

The juices of this root contain prussic acid. In the process of manufacture by washing and drying the poisonous matter is eliminated, and the starch is sold in the market, and cassava and cassava flour produced. From the former is obtained the tapioca of commerce, the difference between the tapioca and the starch consisting in the fact that the former is prepared by being dried quickly on hot iron plates, and the latter slowly in the sun.

The manioc (*Manihot utilissima*) succeeds well in nearly all the districts in the intertropical and temperate zones, but chiefly in dry soils, and especially sandy ones. It is from this tuber that the celebrated Brazil tapioca is obtained, the cassava flour, different pastes, starch, the sauce known locally as tucupy (the cassareep of British Guiana), and some alcoholic liquors. The cultivation requires so little care, and the different preparations obtained from the roots are so cheap and easily made, that even at a reduction of 50 per cent. on the present prices, the tapioca and starch yield large profits to the growers.

The manioc is cultivated very largely in Brazil, furnishing the chief aliment of the fourteen million inhabitants of the empire. The harvests there are very abundant, because of the natural moisture of the climate and the richness of the soil. The bitter species is the most productive. The natives give it the name of *Mani-oca*, which signifies house of Mani. From that name the French have derived manioc, and the Portuguese mandioca. By the Spanish it is frequently known as Yuca. It grows anywhere in the moist plains near the sea, in the depths, and on the hillocks and slopes, as high as 3000 feet. In the damp plains they cultivate it in straight ridges; on the hillocks, or on the divided lands, the cultivation is made flat.

They begin by pulling up the roots and then remove the thick grey rind. Each root is then pressed by hand against the grater or rasp. The fibrous pulp falls into a wet sack, and is then pressed by a very primitive engine, either lever or screw. It is then ground and pressed again. Finally, the pulp is dried rapidly by heating and stirring in a very flat basin. Thus the manioc farina or flour is obtained. The same sediment serves to manufacture the tapioca. This is made by throwing it, well drained, into a copper basin over a fire, taking care not to overheat it. The damp sediment begins to crisp and bake partially, forming small lumps, half transparent and very irregular.

The composition of a large-sized tapering root of bitter cassava, made in Jamaica, by Mr. Louis Hoffman, island chemist, was as follows:—

	Per cent.
Reddish-brown cuticle	0.45
Tunica	3.84
Starch (not including that of tunica)	23.57
Fibrous residue (not including that of tunica)	10.28
Dry extract from juice	3.58
Water	58.28
	100.00

An analysis, made at Washington, of a root gave the following result :—

	Per cent.
Water	12.81
Ashes	1.93
Fat	2.02
Fecula, sugar, and gum	68.19
Fibre	2.27
Albuminoidis	12.78
	100.00

= 2.04 nitrogen.

It produces enormously, especially in dry, thin, and sandy soils. The preparation of this flour is so cheap, the culture of manioc so easy, and the yield so large, that although the selling price has been reduced 50 per cent., yet there remains still a large profit to the cultivator of a product so extended.

The labour required for its cultivation is comparatively small and of the simplest kind. Except during the first month or two its growth is almost independent of rainfall or irrigation. Its productiveness is larger than that of any other article coming under dry cultivation. The mode of preparing it for the market, or for domestic consumption, is simple. The dietetic nature of it is excellent.

From the roots of the two species many food products are obtained, among others, coarse cakes made by rasping and pressing the root, which are cooked on a hot plate.

No less than thirty varieties of the manioc (*Manihot utilissima*) are grown in Brazil, and of all the crops it is the one that gives the best return and the least trouble. An intelligent planter at Campos states that the square of 220 yards will grow 40,000 plants, which even in inferior soil will produce regularly 80,000 lbs. of farina. The preparation of tapioca is easy and inexpensive, and also profitable. It has the further advantage of serving as food for cattle.

Farinha de mandioc, in its crude form, is often seen at Brazilian tables, but is more frequently mixed with water and baked in thin cakes, in this state forming the bread of the poorer classes. It thus forms a nourishing and cheap food.

Manioc meal is produced on an extensive scale in the province of Santa Catharina, where they employ improved machines for preparing it, especially in the settlements. These producers supply the markets of the capital and of the other provinces. Manioc is the staple article of food for the whole population.

There are two modes of preparing the root—the wet and the dry processes. In the first, the grated root is put into water for four or six days, and afterwards kneaded with water, and pressed to extract the juice. The fecula which remains is sifted and baked in earth ovens, some fresh manioc paste, which has fermented, being always added. There are no less than fourteen varieties of the manioc distinguished in the province of Amazonas, some of which mature in six and others in twelve months.

The dry process is carried on as follows: The manioc is rasped by hand, water added within, and then put to be pressed; afterwards dried, sifted, and subsequently baked. In making the starch the deposit in the water is left for some time to allow the starch to settle down; it is washed three times, dried in the sun, and is then fit for sale.

The carima, or fine, creamy starch, is prepared by softening the puba manioc in water, after which it is strained and pressed in a sieve, and made into little balls, in which shape it comes to market, although sometimes reduced to farina. It is used in gruels and other food preparations, according to the custom of each locality.

TAPIOCA EXPORTED FROM BRAZIL.

			Kilos.				Kilos.
1839-40	..	..	1,088,790	1881	..	..	2,473,592
1879-80	..	..	4,158,659	1882	..	..	3,127,614

The value of our imports of farinaceous substances from Brazil (nearly all tapioca) were, twenty years ago, as high as £15,000; now they are only about £3,500.

The bitter cassava is now largely grown in Travancore, where the soil seems so well suited to its cultivation as to warrant a still more extended growth. The produce has been estimated in Ceylon at 10 tons of green roots per acre; this weighs one-fourth when dried, and if the dried roots gave half their weight of flour it would amount to 2,800 lbs. per acre.

Highly cultivated land yields 20 tons of the fresh tuberous roots per acre, and this in one year would be equal to 5 tons of meal. Cassava cakes made of this meal are considered a great delicacy. They are wholesome and nutritious. This plant grows best in dry localities.

The Straits Settlements.—In Singapore the tapioca manufacture has been successful, but the crop is said to entirely exhaust the soil in five years.

The imports of tapioca from the Straits Settlements into the United Kingdom were, in 1855, only to the value of £112,000, now they average about £200,000.

Manioc is much cultivated in North Borneo by the natives, and some of the tubers, more particularly those from the Kina Batangan district, are of immense size. Should there be any permanent rise in the price of tapioca, it can probably be cultivated at a lower cost in North Borneo than elsewhere.

SAGO has been described at p. 271, under the section of "The Useful Palms."

The SWEET POTATO (*Batatas edulis*) is most probably a native of America. It is largely grown in the West Indies, and its cultivation in British India became general in the 18th century. It is now cultivated to a limited extent in almost every part of India. It requires very little care, and grows in any soil. There are two kinds, the one with red, and the other with white tubers. They are eaten by all classes of natives in the East, either roasted or cooked in curry.

The sweet potato grows very well in Brazil, where it is known as camote, and gives a starchy deposit of superior quality. The yield is considerably more than 23 per cent.

There is a manufactory at Porto Real, Province of Rio, for the extraction of starch from the sweet potato and transforming it into glucose and alcohol. This tuber is much grown also along the east shore of Virginia, Delaware, New Jersey, &c. Large quantities come to New York from Norfolk and Richmond, the consumption in the States being very large. In the Southern States millions of bushels are grown annually, and in the Bahamas and Bermuda they form an important article of food.

Thanks to Baron de Lareinty and the investigations of the eminent chemist, M. Basset, the culture of *Batatas edulis* has been carried on on a large scale at Martinique. It furnishes a spirit of a mild and pleasant flavour. A distillery has been established with excellent results, and it is anticipated that the culture of this tuber will become a source of profit to that colony, which, like others, has suffered from the sugar crisis.

The New Zealand sweet potato (*Ipomœa chrysorrhiza*, Forst.), the kumara of the natives, is highly recommended, and has been successfully introduced into Jamaica. It is a rich yellow variety with fine large tubers, is very prolific, and of good flavour.

This useful plant is closely related to the sweet potato (*Ipomœa Batatas*, Poir.). It is grown by the Maories to a great extent, and is, in fact, one of their chief articles of food. It seems only a variety of the sweet potato, widely cultivated in the Pacific Islands and elsewhere. Tubers have been widely distributed from there over Europe and the West Indies. It possesses the advantage of a convenient size, resembling the common potato in this respect, and may be cooked and served in almost as many ways. There are about thirty marked and permanent varieties cultivated by the natives in New Zealand; some are red-skinned, some purple, and others white; some are even and cylindrical, others are deeply grooved or regularly channelled; some are short and thick with obtuse ends.

The young tubers when taken up are carefully scraped and half dried on clean mattings in the sun, being turned every day and carefully covered from the dew. When dry they are either eaten

or put away in baskets as a kind of sweet confection or preserved tuber, and are held in great estimation by them, eaten either raw or soaked, and mashed up with a little warm water.

THE YAM TRIBE (*Dioscorea*).—This family of plants is spread over all the intertropical regions, and each continent possesses particular species. The various kinds are distinguished by the shape and colour of the tubers. The West Indies is their favourite country. They are there what the potato is to Ireland. The negroes live almost entirely on this nutritious esculent, and care for little else when they can get it. The tubers abound in farinaceous matter, and often attain a large size. Yams are universally cultivated among all the tribes of the islands of the Eastern Archipelago, and generally most so where rice is least abundant, but they nowhere form the chief bread of the people as rice, sago, or maize do.

The species chiefly preferred in the West Indies are the negro or red yam (*Dioscorea alata*), the afou or Guinea yam (*D. aculeata*), the buck yam (*D. triphylla*), and the common yam (*D. sativa*).

Yams are usually propagated by pieces like the potato, which must be cut so as to leave some of the skin on them. They require a warm dry soil, or newly-cleared rich forest land, and in such situations yield in large quantities.

There is now an export of yams from Jamaica to other islands; the shipments were in:—

	Year.	Quantity.	Value.
		Cwts.	£
	1885	24,021	10,809
	1886	18,142	9,071

NEGRO YAM (*Dioscorea alata*).—This yam is a tuberous root, weighing from 50 lbs. downwards, and constitutes the chief food of the negroes. There are over 50,000 acres under culture with it in Jamaica.

The Coco or EDDOE (*Colocasia esculenta*) is cultivated in India for the tuberous roots, which are, however, inferior to yams. They are the Tannias, or Tayas, of the Spanish.

The *Alocasia Indica* is generally cultivated around the huts of the poorer classes in Bengal. Its esculent stems and root-stocks form there important articles of food.

The *Curcuma angustifolia* is an abundant plant, wild and cultivated, in some parts of India, as, for example, at Travancore, where a good quantity of arrowroot is prepared from the tubers.

Most of the roots which have been mentioned are valuable for the starch they yield, and give a heavy return. Arrowroot pro-

duces about 100,000 lbs. of roots to the acre, giving 2,000 lbs. of starch; cassava and yams produce 8000 lbs. to the acre, sweet potatoes 30,000 lbs.

JAPANESE STARCHES.—Some of the starches peculiar to Japan are worth special notice; these are the “kudzu,” or starch made from the root of *Pueraria tuberosa* or *Thunbergiana*; the “kata-kuri,” made of the root of a kind of dog’s-tooth violet; and finally the starch prepared from the root of the *Pteris aquilina*. All these three plants grow wild, and the kudzu, which yields the best starch, is very abundant in certain places. It belongs to the Papilionaceous family, grows very rapidly, and in a short time its creepers cover the ground, spreading over the neighbouring bushes and trees their luxuriant foliage. The root is frequently over 5 feet in length, and as thick as a man’s arm. For the manufacture of starch by the ordinary process of crushing the root, washing the starch out and decanting it, moderate-sized roots, 1 foot in length and 1 inch in diameter, are mostly used. The starch is of a fine colour, and has a most agreeable flavour; mixed with warm water it produces a fine transparent paste.

The method of preparing the two other kinds of starch from the roots of the dog’s-tooth violet and the fern—the former of which merits special mention for its qualities—does not present any peculiarity. Both form articles of food, but the fern starch is also used in various industries, as it produces a very strong paste, called “shibu,” on being carefully mixed with the sap of unripe persimmons. The fibres of the fern root, after the starch has been washed out, are made into ropes, which are used in the mud walls of the buildings, so as to afford a better hold for the loam. It may be added that the manufacture of starch sugar has long been known in Japan. Millet and rice are used for this purpose, and after having been steamed, they are mixed with a certain quantity of malt or ferment and kept for several hours at a fixed temperature in close vessels, after which the liquid portion is strained and concentrated by evaporation to a strong syrup or a solid mass, which is formed into bars while still hot. Vendors of this starch sugar are often to be met with in the streets, where, to the great enjoyment of children, they manufacture all sorts of animals and figures with this material, by a process quite similar to that of glass-blowing.

CHAYOTE (*Sechium edule*, Sw.; *Chayota edulis*, Jacq.).—This climbing plant of the Cucurbit family yields excellent fruit, and the heavy tubercular roots contain 20 per cent. of starch. The fruit is green, large, and covered with thorns. In the mountains and inland parts of Jamaica the plant is much cultivated to fatten hogs with the fruit. This is sometimes boiled and served up at table, but the flavour is rather insipid. When sown in a sandy soil, it grows luxuriantly in the first year, yielding abundant fruit. The second year it produces tubercles, which can be taken off without killing the plant. This operation may be repeated for

six or eight years. A plant under favourable circumstances will produce some 80 to 100 pints of fruit and a great number of tubercles. The culture is very simple, and the chayote is not subject to the diseases which affect other tuberous plants. The ancient Aztecs cultivated this vegetable largely, giving it the name of Chayotli, which means squash covered with thorns.

In Europe and America starch is largely made from grain and roots. Under the head of Glucose, p. 216, in the section on Sugar, and under Sago and Manioc, pp. 271 and 346, some information on starches has already been furnished. But the manufacture of starch is carried on on a very extensive scale in Great Britain, many thousand tons being made per annum, for food purposes under the name of "corn flour," and for laundry purposes, for service of calico printers and bleachers, in giving stiffness to the manufactures, and for similar uses domestically.

The factories for making starch from rice are chiefly carried on in London, Belgium, and Germany; those of Glasgow employ chiefly maize. In France the starches made from grain are known as amidon and those from tubers as feculas.

Potato starch may be said to be of French origin, the manufacture having commenced in 1830, and now there are 400 or 500 manufactories there.

The yield of starch from the potato is about 13 per cent., and the annual production in France exceeds 140,000,000 lbs., of which 40 per cent. is converted into glucose, 55 per cent. used in stiffening fabrics, &c., and about 5 per cent. made into edible products—*pâtes alimentaires*.

MAIZE STARCH.—The production of this corn flour is largely carried on in the United States, especially at Oswego and other cities.

The perfect process of manufacturing corn starch is that which economically takes from the kernel all of the starch, and thoroughly frees it from the oil, gum, and glutinous products contained in the whole grain; this requires many washings, in some of which chemical solutions are employed, and most careful manipulation, with the aid of elaborate machinery, besides a great deal of experience in the workmen.

The grain first passes through immense fan mills, to remove chaff and dirt, or any substances which might afterwards injure the machinery. Thence it is passed to enormous vats, where it is soaked, so as to render its constituents more easily separated, that the starch may be extracted. After a sufficient time here the grinding process follows; and for this purpose twenty-four pairs of burr stones and six pairs of heavy iron rollers are used; these mills work day and night, and, operating on wet grain, change it into pulp rather than into flour, the object being to crush and thoroughly disintegrate the particles. This pulp then passes through a great number of screens and drum sieves, which do the first part of the work of separating the starch from the hull, the refuse being used as a food for cattle. *

The milky fluid which results from the washing is conducted into immense cisterns or vats, where it has to receive several washings, during which various solvents and filtered water are used for the removal of all impurities, and the separation of the pure starch from all the other constituents of the grain. After this is done the starch water, as it may be called, is allowed to run into moulds, where, when it has entirely settled, the deposit will have made a long box-like cake, which may be broken into the required squares, each weighing about 7 lbs. after drying, the quantity desired for each package.

SECTION IV.

THE PRINCIPAL VEGETABLE DYE-STUFFS
OF COMMERCE.

INDIGO.—One of the most important vegetable blue dye-stuffs made is indigo. The various kinds which enter into European commerce are from India: Bengal, Tirhoot, Oude, Kurpah, Bimlipatam, Madras, and Kurrachee. From the Eastern Archipelago, Manilla, and Java. From South America: Guatemalan, Mexican, New Granada, and Caracas.

The imports and exports of indigo for the United Kingdom are shown in the annexed return for quinquennial periods:—

Year.	Imports.	Exports.	Year.	Imports.	Exports.
	Cwts.	Cwts.		Cwts.	Cwts.
1840	65,209	40,959	1870	79,255	46,279
1845	90,424	50,380	1875	59,608	56,800
1850	70,482	54,108	1880	58,283	48,215
1855	59,760	64,167	1885	94,556	71,464
1860	77,321	59,366	1887	76,698	53,085
1865	66,506	66,547	1888	78,188	51,131

The great bulk of these imports, it will be seen, are re-shipped to the Continent, the average quantity retained for use in Great Britain being from 20,000 to 25,000 cwts.

The following shows the variations in our sources of supply of this dye-stuff in the last ten years:—

Countries.	1875.	
	Quantity.	Value.
	Cwts.	£
Holland	374	12,619
France and French possessions ..	838	19,200
Austrian territories	435	12,350
Mexico	643	13,978
Central America	9,115	183,955
New Granada	670	18,816
Bombay and Scinde	186	6,249
Madras	12,135	279,116
Bengal and Burma	34,470	1,057,036
Other countries	742	16,534
	59,608	1,618,853

Our imports in 1886 were as follows:—

Countries.	Quantity.	Value.
	Cwts.	£
Germany	204	4,936
Holland	371	8,861
France	449	8,933
Austrian territories	76	2,076
Mexico	334	6,267
Central America	5,971	185,134
Other Foreign countries	295	5,095
Bombay and Scinde	10,742	133,845
Madras	22,170	417,203
Bengal	44,519	1,132,158
Ceylon	169	3,000
Other British possessions	8	47
Total	85,308	1,907,555

India, it will be seen, supplies the chief portion, very little now coming from America.

The imports vary considerably; in 1883 and 1884 the imports of the year exceeded 5000 tons, whilst in other years they reached only half that quantity.

The plants which yield this dye-stuff chiefly belong to the genera *Indigofera* and *Isatis*, but indigos are also obtained from:—

<i>Nerium tinctorium</i> , Rottl.	In the Carnatic.
<i>Ruellia</i> sp.	Assam and Pegu.
<i>Tephrosia tinctoria</i> and <i>T. apollinea</i>	Egypt and India.
<i>Polygala tinctoria</i>	Arabia.
<i>Polygonum Chinense</i> , <i>P. tinctorium</i> , <i>P. barbatum</i> , and <i>P. perfoliatum</i> , Lin.	China and Japan.
<i>Polygonum aviculare</i>	Asia and Africa.
<i>Wrightia tinctoria</i> , R. Brown	Pale indigo of India.
<i>Amorpha fruticosa</i>	Carolina indigo.
<i>Baptisia tinctoria</i>	Wild indigo of the United States.

The *pastel* or woad of Europe is the colouring matter of *Isatis tinctoria*.

The species described by Linnæus were: *Indigofera Anil*, *I. tinctoria*, *I. argentea* and *I. Caroliniana*, plants which grow in a wild state in India, South America, and Africa. Modern botanists have largely extended the list of species. Decandolle raised the number to over one hundred and forty, besides a host of varieties. M. Perottet has well described, in his 'Flora of Senegambia,' twenty-five species; and in his 'Art de l'Indigotier,' Paris, 1842, has published much interesting matter on the whole subject of the culture and manufacture of this dye-stuff. In this he enumerates and dilates on the different works and treatises, to the number of about twenty, which had been published up to that date.

The greater proportion of the indigos of India are prepared from *Indigofera tinctoria*, which is extensively cultivated for that

purpose, in Bengal and other provinces from the 20° to the 30° N. lat., and in Tinnivelly, Madras. There are two processes for manufacturing the dye-stuff: one the *dry leaf*, and the other the *green leaf* process. The latter is considered the best, and is in most common use. It is as follows: When the plant begins to flower, it is cut down at about 6 inches from the ground, and carried to the steeping vats with as little delay as possible, strewn horizontally in the vats and pressed down by means of beams fixed into side posts, bamboos being placed under the beams. Water is immediately run in, just sufficient to cover the plant. If water is not at once let in, the plant will heat and become spoilt. The time for steeping depends much on the temperature of the atmosphere, and can only be learnt by experience and careful watching of the vats; but in close sultry weather, with the thermometer at 96° in the shade, eleven or twelve hours are sufficient. In cooler weather, fifteen or sixteen hours are requisite. If the plant is very ripe, the vat will be ready earlier than if the plants were young and unripe. The following are indications that the vat is ready to let off:—

1. As soon as the water begins to fall in the vat.
2. When the bubbles that rise to the surface burst at once.
3. On splashing up the surface water it has an orange tinge mingling with the green.
4. The smell of the water. When ripe, it should have a sweetish, pungent odour, quite different from the raw smell of the unripe, green-coloured water.

About seven men enter the vat and agitate it, either by the hands or with a wooden paddle, at first gently, but gradually increasing as the fecula begins to separate, which is known by the subsidence of the froth, and the change of the colour of the water from green to dark blue. The time necessary for this beating process is generally from $1\frac{3}{4}$ to 3 hours.

The following tests may be employed to ascertain if the beating has been sufficient:—

1. Take a little of the water in a saucer and let it stand. If the fecula subsides readily, and the water remains of a Madeira wine colour, the beating may be stopped.
2. Dip a coarse cloth in the vat, and wring out the water, observing the colour. If green, the beating must be continued, but if a brownish colour, it is ready.
3. When sufficiently beaten, the surface of the water will, as soon as the beating is suspended, become of a peculiar glassy appearance, and the froth will subside with a sparkle and effervescence like champagne.

Three or four chatties of cold water or weak lime water are then sprinkled over the surface, to hasten the precipitation of the fecula, which does not completely take place in less than three or four hours. The water is drawn off from the surface through plug-holes in the wall of the vat. The fecula at the bottom is then removed to the boiler. It is brought to the boiling point as quickly as possible, and kept there for five or six hours. While boiling, it is

stirred to keep the indigo from burning, and skimmed with a perforated ladle. When sufficiently boiled, it is run off to the straining table, where it remains twelve or fifteen hours draining. It is then taken to the presses and gradually pressed. This process takes twelve hours. It is then ready to be taken out, cut, stamped, and laid in the drying house to dry.

A good-sized steeping vat is 16 feet by 14 feet, by $4\frac{1}{2}$ feet in depth. The beating vat is somewhat shallower. Two hundred maunds of the plant (16,400 lbs.) do very well to yield one maund of indigo (82 lbs.). A vat of the above size holds about 100 maunds of plants. The plant sown in June is cut three months afterwards and manufactured. A second crop will be taken from it in the following August. This cutting produces the largest quantity and best quality.

In the manufacture of indigo the ordinary processes of fermentation, of drawing off the liquor, of beating and of collecting the fecula, or precipitate of indigo, from the liquor, and pressing, are generally well known, and are followed with but trifling variations in different provinces and manufactories in India.

The main points appear to be the watching the soaking plants, so as to be able to tap off the infused liquor exactly at the right point of fermentation, and next, to beat the liquor in the second vat long enough. Knowledge of these things can only be acquired by careful observation and long experience.

The indigo of commerce is the result of the action, by atmospheric oxygen, on the liquor drawn from a vat in which the plants have been decomposed in water, the oxidation producing an insoluble granulation of particles, commonly known as indigo fecula, which is found deposited at the bottom of the vat. The indigo blue is derived from a substance similar to the *indican* of woad, that exists in the plant as a glucoside compound, and which is dissolved during the steeping process.

Mr. Paul Michea, by Indian patents dated December 20, 1875, and November 12, 1876, adopts some improvements in the processes, and thus utilises the whole of the natural alkalies of the plant. He introduces solutions of sugar or glucose in the steeping vat along with the water, at a higher degree of temperature (95° to 100° Fahr.) and a longer fermentation, and thus increases the production of indigo blue.

Similar results are also obtained by replacing the effects of a higher temperature, or a prolonged fermentation, by an artificial supply of alkalies, principally ammonia. It is necessary to remark that the glucoside juice in the plant varies considerably under the difference of latitude and the various countries where indigo is grown, and also according to seasons.

It is only when the quantity of indican is deficient, as in plants grown in a poor soil and under a dry climate, that the ordinary manufacturing process can utilise the whole, or nearly the whole, of the indican for its transformation into indigo blue; but, on the contrary, plants grown in a rich alluvial soil, and under a damp hot climate, will contain an abundance of that glucoside juice which

the present process of manufacture cannot possibly utilise, so that the richer the plant and the more indican it contains, the greater is the waste in the ordinary process.

The indigo plant is chiefly cultivated in Bengal, in the Delta of the Ganges, on those districts lying between the Hooghly and the main stream of the former river. The ground is ploughed in October and November, after the cessation of the rains; the seeds are sown in March and beginning of April. In July the plants are cut when in blossom, that being the time when there is the greatest abundance of dye-matter.

A fresh moist soil is the best, and about 12 lbs. of seed are used for an acre of land. The plants are destroyed by the periodical inundations, and so last only for a single year. When the plant is cut it is first steeped in a vat till it has become macerated and parted with its colouring matter; then the liquor is let off into another vat, in which it undergoes a peculiar process of beating, to cause the fecula to separate from the water; the fecula is then let off into a third vat, where it remains some time, and is then strained through cloth bags and evaporated in shallow wooden boxes placed in the shade. Before it is perfectly dry, it is cut into small pieces an inch square: it is then packed up for sale. Indigo, however, is one of the most precarious of Indian crops, being liable to be destroyed by insects, as well as inundation of the rivers. It is generally divided into two classes, viz., the Bengal and Oude indigo. Madras indigo is not much inferior to that grown in Bengal. The green leaf manufacture is followed in all the indigo-growing districts of the Madras Presidency, save the province of South Arcot. In the latter the dry leaf process is still persevered in, but probably it is so only because of the distance to which the leaf has generally to be carried before it reaches the factory, and the consequent partial drying that takes place on the journey. The best indigo comes from the districts of Kishnagur, Jessore, Moorshedabad, and Tirhoot.

The fecula is much improved after being collected by being boiled in coppers and then pressed into boxes. Indigo is sometimes manufactured by simply collecting the fecula, and dropping it down in cakes to harden in the sun; this is termed "gaud indigo."

Good indigo is known by its fine purple-blue colour, and by its fracture; but when exposed to the continued action of air or water, or any other agents, it undergoes certain changes, which differ very materially in various grades or qualities of the article, and, unless a person is a good judge, he will be unable to tell the grade and quality. This can only be determined by closely examining the indigo in some test process. Good indigo is always very light—the lighter the better—that is, the freer it is from all foreign earthy matters; and if rubbed against a white cloth it does not easily colour it. Another sure test is its handsome copper gloss. This may have been caused by the rubbing of the angles of the pieces while in transportation, or it may be made by rubbing them with any hard substance. This copper gloss is the consequence of

the mechanical thickening of the colouring matter with which indigo abounds; in this it resembles all pure colouring matters.

One thing to be especially remarked is the fine dark colour of the indigo powder, which can easily be obtained by rubbing and grinding the indigo lumps. By closely observing the above directions a person will be less at fault in his selection of an indigo, as some show a greenish colour, break with a brownish edge, and have white veins through, or show white veins in the heart of the lump.

The quantity of indigo exported year after year is largely dependent on the crops, the culture of which is always very uncertain; but the value fluctuates according to the needs of the European markets and the abundance or otherwise of supplies from South America, as well as the quality of the dye produced in India. The chest of indigo from Bengal weighs about 260 lbs.

The following shows the total exports of indigo from British India to foreign countries:—

Year.	Quantity.	Value.
	Cwts.	£
1863	101,115	..
1873	115,312	3,426,824
1883	141,041	3,912,997

The value of the indigo exported from British India ranges from £2,000,000 to a little over £4,500,000 a year. It is however a very variable crop.

The fluctuations in the money value of the indigo exported, leaving aside the quantity retained for local use, are shown as follows:—

1851	..	..	..	1,980,896	1881	..	..	..	3,571,581
1871	..	..	..	3,192,503	1887	..	..	..	3,898,409

Attention has been given of late to the cultivation of indigo in Upper Sind and in different parts of the Kurrachee Collectorate. The soil there is the same as that on which indigo is so successfully raised in Bengal. The Government are willing to encourage the ryots, with whom the cultivation is rising in favour, to extend it, by offering rewards to the most successful among them, and giving long leases of land to parties who will venture on the speculation on a large scale. Nothing will be effectually done till Europeans and European capital are engaged on it, and a fee-simple of the land will soon draw these to Sind.

In 1870 there were 267,000 acres under indigo in the Madras Presidency, and 101,000 acres under chayroot and other dye-stuffs, chiefly in Bellary and Tanjore.

The returns for Bengal are not published, but were estimated at 710,000 acres in 1886. The following was the average under indigo: Madras 292,757, Bombay 3986, North-West Provinces

458,562, Oudh 19,657, Bengal 131,926, Central Provinces, Lower Burmah, and Berar 200; total 1,617,088 acres.

The substance known in the market as Madras indigo is prepared from the *dried leaves* instead of the fresh green twigs used in Bengal and the North-West Provinces. The ripe plant is dried in sunshine, and thrashed to separate the stems from the leaves, which are then stored. In the course of four weeks the leaves undergo a change in colour, from green to pale blue-grey. They are then macerated in water, and the dye extracted in the usual way. The best indigo is exported from Calcutta. That which is shipped from Madras, Sind, and Bombay is of inferior quality and lower price.

Indigo is a very fickle product, and is very subject to fluctuations, a short crop sending up the prices to a very disproportionate figure, while a large supply makes stocks saleable at only very reduced rates. The quality of the crop, moreover, in each year is very uncertain, the bulk of it one year being probably of good quality, while in the next, on the whole, it may be very indifferent.

A good deal of indigo is used in the country by native dyers, but of a kind which never goes to foreign markets. There is enough grown in various parts of the peninsula for local consumption.

The indigo plant is cultivated to a greater or less extent in almost all the non-mountainous districts of the North-Western Provinces, but most extensively in those districts where canal irrigation is available. In India the indigo plant is grown by cultivators either on their own account or on the account of capitalists, from whom they generally receive advances to meet the expenses of cultivation, and to whom they are under an obligation to sell all the plants produced at a fixed rate. With all its disadvantages this latter system is the only means of bringing about the application of extraneous capital to land, without which the cultivation of indigo would often be impossible.

The indigo of commerce results from the atmospheric oxidation of the indican dissolved in water, which forms a compound (called the *fecula*) insoluble in water, alkalis, or acids. The process of extracting the dye from the leaves may be broadly considered as the extraction of the indican by continued soaking of the leaves in water, and its subsequent oxidation by agitating the solution, and so exposing it to the action of the air. The plant is cut before flowering to within six inches of the ground, and carried to to the factory, where it is at once thrown into masonry vats, and covered with water. For the European market, the sediment of colouring matter which is obtained from the leaves of the plant is invariably boiled, whence the cakes are known as *pakka* or cooked; but a great deal of the indigo consumed in the Indian market is of the *kacha* or raw kind, that is prepared from the unboiled sediment.

A factory in which indigo is manufactured, chiefly for export, consists of a double row of masonry vats, a furnace with boiler, and apparatus for straining the sediment and making up into

cakes. To prepare *kacha* indigo, all that is needed are some masonry vats, which are generally sunk in the ground.

Good indigo cake should contain from 50 to 60 per cent. of indigotine (or oxidised indican); be bright, of a dark blue colour, with a coppery gloss, breaking with an evenly coloured fracture; and should not part with its colour by light friction.

As a rule about 73 cwts. of plant are steeped in a vat 20 feet square and $3\frac{1}{2}$ feet deep; it is considered a good out-turn if this gives 25 lbs. of indigo cake.

Most of the indigo for consumption in India is not boiled, but prepared in the so-called *kacha* form at numerous village manufactories, which consist merely of two or three masonry vats sunk in the ground without the more expensive accessories of furnace and straining room.

As in the factories, the process commences by steeping the plant in water, which is allowed to continue for one night. The surface water is then drained off, and the soaked plants are trodden out by men for about six hours. Some Dhak gum (*Butea frondosa*) is then added in the proportion of about 6 ounces per vat; water is again run into the vat and the steeping continued for a few more hours, when the water, loaded with indigo particles, is drawn off into another vat, well beaten, and the fecula allowed to settle. When this has taken place the surface water is drained away, and the muddy-looking residuum, collected in earthen or metal pans, strained and spread out on cloths resting on a layer of sand. In this way the remaining moisture is absorbed. The indigo is then moulded into cakes, each about the weight of 8 ounces, and finally dried on ashes and in the sun, and after about a week is ready for the market. The imperfect manner in which the leaves and fibres of the plant are separated from the fecula and the addition of foreign substances, like gum, to assist fermentation, result in the production of indigo very inferior to that made up in factories so called, however well suited to the moderate requirements of the dyers of the country. For mere domestic use, when the dye is to be utilised as soon as extracted, the plant is simply steeped in a closed basin in water in which a little carbonate of soda or shell lime has been dissolved, and kept so for five or six days, till it begins to ferment, when it is ready for use.

The yield in Bengal for 1884-85 was 108,692 maunds, that of 1885-86 was estimated at 76,109 cwts. (1,103,693 maunds).

The cultivation of indigo in Madras is rather on the decline, only 308,101 acres being under crop in 1885-86, or 21,000 acres less than the previous year. There are a great number of indigo factories in Bengal, and the North-West Provinces. Many small factories in these provinces, as well as in Madras, are now owned and worked by natives. In the Punjab there are said to be thirty-nine factories, and in Rajputana one.

INDIGO EXPORTS from INDIA, YEARS ENDING MARCH 31.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	cwts.	£		cwts.	£
1877	100,384	2,962,786	1883	141,041	3,912,997
1878	120,605	3,494,334	1884	168,590	4,640,991
1879	105,051	2,960,463	1885	154,629	4,068,900
1880	100,935	2,947,434	1886	132,495	3,783,160
1881	116,870	3,571,581	1887	138,396	3,691,677
1882	150,363	4,509,108	1888	139,928	3,898,409

Prices of good consuming quality fluctuate much. The price of Bengal indigo per pound on December 31st in each year was as follows:—

				s.	d.					s.	d.
1871	..	..	..	9	0	1878	..	..	..	5	5
1872	..	..	..	6	9	1879	..	..	..	7	10
1873	..	..	..	6	8	1880	..	..	..	7	0
1874	..	..	..	7	0	1881	..	..	..	7	0
1875	..	..	..	5	0	1882	..	..	..	6	3
1876	..	..	..	6	7	1883	..	..	..	6	3
1877	..	..	..	5	6	1884	..	..	..	5	8

Of 154,629 cwts. exported in 1884, 106,069 were shipped from Calcutta, 42,000 from Madras, 3,376 from Bombay, and 3,183 from Karachi.

The consumption of indigo in the United States has increased of late in a large ratio. There was shipped from the United Kingdom of Indian indigo:—

			Cwts.					Cwts.
1882	..	..	..	14,386	1885	..	..	11,786
1883	..	..	..	12,454	1886	..	..	11,001
1884	..	..	..	10,648				

and direct from India:—

			Cwts.					Cwts.
1884	..	..	..	21,194	1887	..	..	28,133
1885	..	..	..	25,082	1888	..	..	21,350
1886	..	..	..	20,737				

They also now buy largely from Salvador, and instead of 400 or 500 bales as in former years, they now take about one-sixth of the entire crop, or, say, 2000 or 3000 bales.

The value of the indigo produced yearly may be taken at £8,000,000, of which India produces one-half, and China, Manila, Java, and Central America the rest. The present mode of manufacturing indigo from the plant is extremely rude and imperfect, and by an improved and more careful carrying out of the process, great saving in colouring matter might be effected, so that it may prove possible to produce a finer article at a lower price. The chest of Bengal indigo weighs 260 lbs. net.

Of late years a considerable quantity of indigo leaf has been

sent from the Mofussil to Pondicherry, there to be made into dye. The reason for this is that the leaf is free of duty, while the manufactured dye pays a duty of Rs. 3 per maund. About 2000 lbs. of dry leaf, or 1000 lbs. of green, are required to make a maund of indigo.

In the French territory surrounding Pondicherry there were in 1860 1100 hectares of land cultivated with indigo, which produced 6,962,000 kilos. of dry leaves, from which 37,131 kilos. of indigo were made; there were then ninety-two indigo factories.

The number of indigo manufactories in Pondicherry and Karikal in 1885 was but eighty-four; 395 hectares were under culture, which produced 288,261,047 kilos. of dry leaf.

M. Jules Lepine gives the following as the expense of cultivating a small cani (53 ares, 51 centiares) with indigo in Coromandel; the are is equal to a square of 1076 feet:—

	Francs.
Labour	9.60
Manure	7.20
Seed	2.40
Weeding	4.80
Cutting	9.60
Drying and separating the leaves	3.00
Land tax	5.78
Total	42.38

The three cuttings made during the year produce 20 hectolitres of leaves, which, being sold for 47 frs. 20 c., leaves a profit of 24 frs. 20 c. for the cultivator. Sometimes sesame is sown in the same land, which is harvested before the indigo leaves are cut.

Cochin-China.—This invaluable plant, one of the most important in modern manufactures, and which even the aniline dyes are not likely to dethrone, must be regarded as one of the chief products of Cochin-China and Cambodja, where it grows with extraordinary vigour. There were 332 hectares under indigo in 1885.

Of the numerous species two or three only have attracted the attention of cultivators. The plants which grow in Cochin-China are equal to those of India proper, and the indigotine, or dyeing quality, possessed by the local species (*Indigofera tinctoria*), contains all the necessary principles to enable the plant producing it to take a high rank.

On attaining its full growth it is about 6½ feet in height, and even taller if it has not been cut back. It is cultivated in beds of sand, or on the light alluvial washings of the upper tertiary formation, that is to say, in light soils seldom subject to the effects of heavy floods.

Although capable of living many years, it is advisable to renew the plants annually. Its growth takes place between February and July. When it has arrived at maturity the leaves are collected in bundles and carried to the factory, where the process of manufacturing the paste is carried out; this, in order to be of first-class quality, should be light in weight and of a very light sky-blue colour.

Siam.—A small quantity of indigo is produced in Siam. In 1875, 481 piculs, valued at £200, were shipped.

China.—Although there exist in China varieties of *Indigofera tinctoria* and *I. anil*, these are not much cultivated. Dr. Williams states *I. coccinea* is grown, and Loureiro, *I. tinctoria*. In the southern provinces there are plantations at Kouang-si, Kouang-ton, and Fokien. *Isatis indigotica*, Fortune, is grown in almost every province of China. *Ruellia indigotica* is cultivated for its dye in the province of Tchekiang. Preference is given in the north to *Polygonum tinctorium*, especially about Pekin; but *P. chinense*, *barbatum*, *perfoliatum* and *aviculare* are also employed.

Indigo is cultivated and manufactured by the Chinese in Krian, Perak, and in 1884, 2590 dollars' worth was exported. A good deal is used locally in dyeing the dark-blue cloth that is almost universally worn by the labouring classes of Chinese.

Japan.—Large indigo manufactories are now in working order at Osaka, Matsubara, and Tunaki, in the province of Omi, Japan, and it is proposed to establish more in other provinces of the same country.

The indigo here is obtained chiefly from the *Polygonum tinctorium*. The plants, which grow to a height of 2 to 3 feet, are cut into three parts, the upper part with the greatest number of leaves being the richest in colouring substance. For the best quality the leaves only are used; these, after having been exposed to the air and sun during a few hours only, when they darken considerably, are put into straw bags and kept for the purpose of afterwards undergoing a longer treatment. This consists in moistening the leaves with a certain amount of water, the exact quantity of which depends on the nature of the leaves, and the greatest care must be taken to prevent its being either in excess or in deficiency. They are then spread out upon and covered with mats during a few days, after which the operation is repeated during a period of eighty days, about twenty-five times for the best, and about nine times for the inferior leaves. Having undergone this kind of fermentation they are then pounded in wooden mortars, in quantities of about 30 lbs., for two consecutive days, so as to become reduced to a sort of paste, which is then formed into balls of a dark-blue colour. These balls of crude indigo, with an addition of bran and potash lye, prepared from wood ashes, form the material used by dyers in the steeping vat.

Java.—Of the products of Java indigo is a principal one, with a few exceptions; it is chiefly grown in the two residencies of Sourakarta and Djoejokarta, which are not under the control of the Dutch Government, but rest under their ancient chiefs, who are absolute masters. The tenants have to give one day's labour weekly to these chiefs or the value in kind; but, under arrangements controlled and recognised by the Dutch authorities, the lands are leased for twenty years, and there are many factories carried on under these terms. The production is rather declining, owing to the fluctuating prices, and much improvement is required both in cultivation and manufacture. At the commence-

ment of the season of 1886 the price was from $3\frac{1}{2}$ to $4\frac{1}{4}$ florins in the island, but these gradually fell to 2 florins for the best quality indigo, and 1 to $1\frac{1}{2}$ florin for inferior kinds.

This price not satisfying the planters, the greater quantity of the production was shipped to Holland. From 1880 to 1884 the average annual export was 422,000 kilos., and in 1885 and 1886, 610,000 kilos.

The plant generally cultivated for this dye in the Eastern Archipelago is the *Indigofera tinctoria*, the same usually grown on the continent of India. It is said to be indigenous, at least in several islands, and this would seem to be confirmed by its having everywhere a native name. This name is generally the same in all the languages, for there can be little doubt but that the *tarum* of the Malay, the *tom* of the Japanese, the *tayumand* of the Tagala and Bisaya, are one and the same word. But the case is different with the dye, for this is always called by a foreign name—the well-known Sanscrit one—*nila*, literally “blue.” From these two facts it may be at least conjectured that the Hindus taught the inhabitants of the Archipelago the art of extracting the dye and using it—that the plant is indigenous, and that the culture of it, along with the art of manufacture, were conveyed from the western nations of the Archipelago, those nearest to the Hindus and most in communication with them, to the more remote tribes, as in the instance of the people of the Philippines. All the indigo manufactured by the natives of the Archipelago is in a liquid and fetid form, and the process of drying the pure fecula is entirely one of European introduction, conducted nowhere but in Java and the Philippines, and then always under European or Chinese superintendence.

Indigo is grown principally in the middle provinces, where there are some eighty plantations. Mr. Joseph Sayers, of Java, has carried out some improvements in the manufacture of indigo, which are remarkable for the increase of indigotine obtained and the uniform results shown.

Good ordinary Bengal has only an average of 61·4 of indigotine. We sometimes meet with 75 to 80 per cent. of indigotine in very fine samples of Java and Bengal indigo, but these are exceptional cases. The fact is that in commerce there is generally only about 10 per cent. of very fine indigo, 35 per cent. of medium quality, and 55 per cent. of ordinary. Indeed, it may be said that not 10 per cent. of the indigos of commerce contain more than 65 to 66 per cent. of indigotine, which is the minimum proportion of the Sayers' indigos of Java.

INDIGO SHIPMENTS, NOT PREPARED for the LOCAL MARKETS, sent from JAVA,
in KILOGRAMMES.

1872	..	..	..	33,038	1879	..	..	..	365,845
1873	..	..	..	346,275	1880	..	..	..	373,273
1874	..	..	..	386,700	1881	..	..	..	415,000
1875	..	..	..	323,972	1882	..	..	..	420,000
1876	..	..	..	494,368	1883	..	..	..	442,000
1877	..	..	..	526,706	1884	..	..	..	479,000
1878	..	..	..	346,892	1885	..	..	..	600,974

Philippines.—The indigo plant is found in several provinces, but the best quality comes from the north of Luzon.

The leaf is at times affected by the attacks of locusts and by storms, but growers in good years realise as much as 90 per cent. profit. The process of making the indigo is primitive enough, and is somewhat as follows:—

The plants are cut in April or May, they are then placed in casks filled with water. After being left to steep for some time they are removed, and a certain quantity of lime mixed with the water. The water is then poured into other casks, where it remains until the colouring matter is deposited. As soon as this has taken place the water is drawn off, and the indigo left to dry. It is then cut out in small pieces.

Imperfect as this way of manufacturing the indigo is, it still fetches in the market from 35 to 75 dollars the cwt. The plant is rich in indigotine, but the defective preparation makes it rank second in quality as compared with Indian indigo. The exports in 1864 were 98 tons; and in 1875, 3165 cwt.

Africa.—On most parts of the eastern and western coasts of Africa species of indigo are indigenous.

According to Dr. Barth and other travellers who have visited the Soudan, the indigo plant grows wild in all the forests. In each town vats are met with, in which the plant is steeped and the dye prepared into cakes. Cakes brought from the Soudan and analysed were found to contain 53 to 54 per cent. of indigotine. The indigo is taken by the caravans by the way of Mourzouk to Egypt. In Tunis indigo is cultivated at Nabel and certain parts of the coast, but of a quality very inferior to that imported.

At Sierra Leone, Liberia, Abeokuta, and parts of the Niger, Natal, and the Cape Colony, indigo plants are abundant, growing wild, and many are utilised by the natives.

The African indigo from Egypt and Senegal, though yielding a good dye, is generally much contaminated with earthy matters.

Humboldt states that the indigo plants grown in Mexico are *I. anil*, *I. tinctoria*, and *I. disperma*. This product is obtained in large quantities in the States of Yucatan, Oanaca, and Colima.

Guatemala.—The exports of indigo from Guatemala in 1872 were made to the following countries:—

	Cwts.
England	15,598
France	3,830
Germany	10,933
United States	5,872
Belize	3,900
Total	40,133

In 1883 the shipments were only to the value of £3776; and from Honduras, in the same year, £40,000.

Nicaragua.—Indigo was the staple article for exportation in the time of the Spaniards, and even for many years afterwards; but want of labour, capital, attention, and proper protection, during twenty years of revolutionary tumult, has entirely suspended the raising of indigo. It has been found by experience that the indigo raised on the high lands of Nicaragua, although less in quantity, is far superior to the San Salvador indigo, which is now represented as being the best in Central America.

All the fine old indigo haciendas are mostly used for grazing cattle; no one will venture his capital in planting indigo under present circumstances. The total amount of indigo exported from Nicaragua in 1858 did not exceed 200 quintals. It is cultivated in the Val Menier, and three crops are obtained from one sowing.

Central America.—The value of the indigo shipped from Salvador in 1868 was \$1,602,000. The quantity produced annually in this State varies from 9000 to 15,000 bales of 150 lbs. Unlike most other crops of the country, only one crop is produced each year, and a smaller second crop from the same seeding. The cost of production is about 2s. 8d. a pound, while in India the cost is stated to be about 1s. There is an export duty here amounting to about 14s. per bale.

The indigo of this State is still classed in Europe under the name of Guatemala; in the country the plant is called *Jiquelite*. Nearly all Salvador is covered with it, both wild and cultivated. The soil, according to its geological composition, is said to produce different results in the indigo. Thus, at the foot of the volcano of San Salvador half a pound of dye is sometimes obtained from a load (150 lbs.) of leaf; and at Santa Barbara and Santa Cruz, some distance from the sea, 13 to 14 ounces only are obtained. About 14,000 serons (of 150 lbs.) are usually shipped. The different grades are specified by numbers—from four to six, ordinary; seven to nine, superior.

The indigo of the Eastern Archipelago is used principally for domestic and laundry purposes, for which the Central American variety is, however, well adapted.

The direct imports from Central America into Great Britain are shown in the following return:—

	Cwts.		Cwts.
1851	5,697	1869	15,763
1852	3,458	1870	12,457
1853	2,017	1871	13,799
1854	206	1872	12,901
1855	2,102	1873	7,800
1862	4,750	1874	10,220
1863	4,281	1875	9,115
1864	3,731	1882	7,192
1865	9,362	1883	5,649
1866	5,641	1884	7,418
1867	10,881	1885	7,073
1868	13,875	1886	5,971

More than half the crop, however, goes to America.

Colombia.—The imports of indigo into the United Kingdom from this State have been as follows:—

			Cwts.				Cwts.
1862	..	..	4,391	1872	..	..	3,961
1863	..	..	1,368	1873	..	..	3,172
1864	..	..	3,743	1874	..	..	1,301
1865	..	..	2,381	1875	..	..	670
1866	..	..	6,565	1882	..	..	112
1867	..	..	1,338	1883	..	..	106
1868	..	..	4,221	1884	..	..	4
1869	..	..	847	1885	..	..	120
1870	..	..	2,267	1886	..	..	78
1871	..	..	4,165				

Venezuela.—In former times indigo was a flourishing industry here, but it has rapidly declined from several causes: among others, in consequence of submitting it to alterations which lower its value in the principal markets of Europe. Secondly, the tedious and unwholesome labour which its manufacture requires, and for which it is difficult to find hands. Hence the culture of other products are preferred. It is shipped in boxes and serons, in the form of irregular pieces and powder; but it is always mixed with foreign substances, and very inferior to the produce of Colombia and Guatemala. In order that the Venezuelan indigo might attain any importance in a commercial point of view, the manufacturer ought to be more careful. In 1873 the shipments from Venezuela were 1633 cwts.; in 1882 and 1883 only 354 cwts. The centre of the culture is San Sebastian, and Porto Cabello is the principal port of shipment.

MADDER.—This important vegetable dye, used in calico printing, is obtained from the root of the *Rubia tinctoria*, a plant indigenous to Turkey and Persia, and now extensively cultivated in France and the countries of Central and Southern Europe. The history of madder dyeing may be traced from its origin in Eastern India, three thousand years ago, through Persia, to Adrianople, Greece, Italy, and Western Europe. The colours were first obtained from a species known as Munjeet (*Rubia Munjista*), then came into use the Turkey madder root. This plant was grown in England in 1624, at which time three qualities were known—cropp, fatt, and mill madders. French madder-root has a peculiar smell, and a taste between bitter and sweet. Some kinds, as those of Alsace and Holland, when mixed with water and allowed to stand for some time, give a thick jelly; this is not yielded to the same extent by Avignon madder. If this madder is treated with an acid it produces a perceptible effervescence, owing to the quantity of calcic carbonate which it contains.

The increased use of aniline dyes has led to the decline of the trade in madder roots. The total growth of madder was calculated some years ago to amount to 47,600 tons, of a value of over £2,000,000 sterling. The value of that used in Great Britain in 1874 was about £800,000; in 1888 it was but £19,292.

The competition of artificial alizarine has led to the gradual abandonment of madder culture. In 1840, in all the French departments, 14,674 hectares were devoted to madder, and in 1862, 20,466 hectares. In 1874 the total area had declined to 5069 hectares. The quantity produced shows a similar development up to 1862, followed by a decline, as indicated in the following table :—

									Kilogrammes.
1840	..	..	..	..	..	..	..	..	24,872,000
1862	..	..	..	..	..	..	..	..	54,357,696
1874	..	..	..	..	..	..	..	..	17,359,600

The exports of madder and madder extract show an enormous decline in value. The following marks the diminution in the period from 1867 to 1876 :—

									Francs.
1867	..	..	..	..	..	..	..	..	30,842,000
1876	..	..	..	..	..	..	..	..	4,607,000

The value of the alizarine imported into the United Kingdom in 1888 was £283,862, and of the other coal-tar dyes, £280,683. Taking the lowest estimate, viz., 9500 tons of artificial madder or alizarine, and calculating its selling price at £150 per ton, the annual value amounts to nearly a million and a half. It is not more than one-third the average price of madder twenty years ago. Dr. F. Versmann, in a paper "On Anthracene and Alizarine," read before the chemical section of the Society of Arts in March, 1874, gave some interesting details on madder. "In the East the madder plant has been known since the earliest times. In Holland it has been cultivated more than three hundred years; in France it has risen to great importance since the middle of last century, especially in Avignon, which now produces about one-half of all the madder consumed, to the value of about £750,000 per annum. Turkey and South Russia also supply considerable quantities of high quality. Some experiments in cultivating madder in Great Britain were made in Derbyshire some years ago, but with indifferent results. The soil, the climate, and the weather have the most decided influence upon the growth of the plant, and the subsequent development of the colouring principle. The Dutch madder will dye red, but not purple, and the colour is not fast; Naples madder dyes red and purple, but the colours are fugitive; that of Turkey dyes good red and purple, and is very fast. France supplies the market with two qualities, called *rosées*, from their dyeing beautiful reds and pinks; and *paludes*, which give a good purple, besides fine reds, considered the best French quality. The last name is derived from the fact that the plants are grown on marshy land. The cultivation of the plant and the ultimate separation of the colouring principles is a matter of much time and uncertainty. The root must remain in the ground for a long time—in France, two or three years; in Turkey, five or seven years—and, after having been dried and coarsely powdered, it must be kept another year or two to develop the colouring principles, which are not ready formed in the root. For many cen-

turies, and until the beginning of the present one, the root was used direct, and no attempt was made to separate the colouring matters or to apply them in a concentrated and pure form, but with the development of technical industry and scientific investigation, the concentration or separation of the valuable constituents gradually commenced. The first step was the manufacture of 'fleur de garance,' madder deprived of all substances soluble in water, and then dried again, which reduced the bulk to about 60 per cent. The washings contain a considerable amount of sugar, which by some French manufacturers is converted into alcohol. A ton of madder gives about 15 gallons of alcohol, of rather unpleasant flavour, but well adapted for technical purposes. Garancine is madder further treated with sulphuric acid, which destroys part of the ligneous fibre, yielding about 25 per cent. in the form of a fine powder of light brown colour. Green alizarine and purpurine are the results of treating madder with sulphurous acid, which dissolves both; after adding sulphuric acid to the solution, and heating to 40° C., purpurine separates about $\frac{1}{2}$ or $\frac{3}{4}$ per cent., and, on further heating to 100° C., alizarine separates about 3 per cent. Yellow alizarine is obtained by further purifying this green alizarine. Extracts of madder are mostly obtained by treating the root with boiling water, collecting the precipitates which separate on cooling, mixing them with gum or starch, and adding acetate of alumina or iron. This is, in fact, a mixture of colouring matter and a mordant, which may be used for printing, direct. These are the principal madder preparations, many of which are manufactured in this country."

The madder root season in Naples commences with August of each year, and terminates in July of the following. It is customary to carry the residue stock of one year forward and to add it to the next season's crop.

The produce of madder roots in France was in

	Cwts.						
1857	..	..	..	..	..	..	420,000
1862	..	..	..	..	..	..	167,792
1872	..	..	..	..	..	..	238,568

The latter was equal in value to about £890,750.

A hectare in well-manured ground, and under favourable circumstances as regards atmosphere, will produce 12,000 lbs. of dry roots, while, under unfavourable circumstances, it will not yield more than one-half or one-fourth of that amount. As the yield varies greatly in successive years, it is difficult to give an average yield.

The foreign demand for French madder is diminishing considerably, but for reds and rose tints madder is still preferred to the artificial alizarine for violets; however, the latter produces much more economically shades fully as rich as those obtained from the plant.

The madder preparation known as *garancine*, which is largely imported from the South of France, is formed by moistening the

ground root with sulphuric acid, and afterwards subjecting the same to boiling heat by means of steam. By this process the colouring principle is altered and improved, and a large proportion of it rendered soluble in water.

Madder is largely cultivated in *Holland*. The annual yield of roots in Zealand is 14,500,000 lbs. It is in the islands of Schowen and Duiveland, and in the zone of land comprised between the mouths of the West Escout and the confines of Belgium, that they cultivate the best roots and those most in esteem for their colouring matter. The average yield per hectare is, for the biennial plant, 2000 to 3000 kilogrammes; for the triennial, 3500 to 5000 kilogrammes.

In *Russia* madder grows wild in the south of the country of the Don Cossacks and in the provinces of the Caucasus. The principal centre where it is cultivated is Kouban, in the Bakou Government, and in the neighbourhood of Derbend, the average production of late years has been from 200,000 to 300,000 pouds (of 36 lbs.) per annum. It constitutes a very important branch of commerce in the Caucasus, and the roots sell at 7 to 8 roubles the poud. It is exclusively employed in the native factories of the interior of Russia. The rapid extension of the aniline colours has, however, had a damaging effect on the native production.

The Industrial Society of Mulhouse, France, a few years ago published a report on the effect of the introduction of artificial alizarine upon the consumption of madder. The employment of the former product is constantly augmenting, and it is manufactured on a large scale in Alsace, Germany, and Russia. It is with the extracts of madder that artificial alizarine comes in competition, but only to a certain extent; for, while it produces violet shades of greater brilliancy and beauty, its reds are inferior. In order to completely replace madder, another principle of that material must be present in the artificial product—namely, purpurine, which furnishes fine orange reds, but of which at the present time even the chemical constitution is not definitely known. Hence it is considered that the best tints can be obtained by artificial alizarine and madder extract combined, employing the latter of the shade of red most closely approximating orange.

MUNJEET.—The majority of the substances used in India for dyeing red partake of the character of madder. The place occupied by this dye-stuff in Europe is supplied in India by the *Morindas* and *Munjeet*. The *munjeet* of Nilgherri is referred to *Rubia tinctoria*, and that of Afghanistan to *Rubia cordifolia*, Lin., or *R. Munjista*, Roxb. It is cultivated in Assam, Nepal, Bombay, and other parts of the country, and has occasionally been exported to England, but has never been much used in Great Britain, as the colours produced from it are neither so fast nor so bright as those obtained with the European madder. It is too expensive a dye to be much used in India.

CHAY ROOT (*Oldenlandia umbellata*, Lin.; *Hedyotis umbellata*, Lam.), another plant belonging to the order Rubiaceæ, is also

known as Indian madder. It is much cultivated in sandy situations on the Coromandel coast, and used to a great extent in the southern parts of Hindostan by the native dyers. The celebrated red turbans of Madura are dyed with it, and also the Madras handkerchiefs or "pulicats."

SAFFLOWER (*Carthamus tinctorius*) is a tall annual, rather handsome herb. The florets produce yellow, rosy, ponceau, and other red shades of dye, according to various admixtures. The pigment principles are carthamin and carthamus yellow. Its colouring matter, called carthamin, "safflower carmine," is a resinoid substance of a very beautiful, but, unfortunately, not very permanent red colour. When exposed to action of air and light it slowly combines with oxygen by elimination of water and carbonic acid, and is converted into a yellow substance. The "pink saucers," sold in shops for various purposes, contain carthamine, and, mixed with talc, it forms the *rouge* used by females for painting their faces.

In France and Spain, the small flowers composing the heads of the thistle are picked off and dried in the shade, whilst in Egypt and India they are squeezed, washed with cold water to remove useless materials, slightly pressed into lumps, and then dried; the latter have about double the value of the former. The safflower so prepared only contains three to six parts per thousand of the colour-giving principle, which has received the name of carthamic acid. We also import a small quantity of "extract of safflower." The dried flowers, which are very much like saffron in appearance, have been employed to adulterate that drug. The florets are used by the Chinese to give rose, scarlet, purple, and violet colours to their silks. They are thrown into an infusion of alkali, and left to macerate. The colours are afterwards drawn out by the addition of lemon-juice in various proportions, or of any other vegetable acid. The dye-stuff is imported into England from many parts of Europe, and from Egypt, for dyeing and painting. The dried florets yield a beautiful colouring matter, which attaches itself without a mordant. It is chiefly employed for colouring cotton, and produces various shades. In Bangalore silk is dyed with it, but the dye is fugitive, and will not bear washing. The flower is gathered and rubbed down into powder, and sold in this state. When used for dyeing, it is put into a cloth and washed in cold water for a long time to remove a yellow colouring matter. It is then boiled, and yields the pink dyeing liquid. The Chinese safflower is considered superior to the Indian. In Assam, Dacca, and Rajpootana, it is cultivated for exportation. That from Bombay is least esteemed. The mode of gathering the flowers and preparing the dye as practised in Europe, where the plant is much cultivated, is as follows: The moment the florets, which form the compound flowers, begin to open, they are gathered in succession without waiting for the whole to expand, since, when allowed to remain till fully blown, the colour is much faded. As the flowers are collected, they are dried in the shade.

This work must be carefully performed, for if gathered in wet weather, or badly dried, the colour will be much deteriorated. These flowers contain two kinds of colouring matter, the one yellow, which is soluble in water, the other red, which, being of a resinous nature, is insoluble in water, but soluble in alkaline carbonates. The first is never converted to any use, as it dyes only dull shades of colour. The other is a beautiful rose red, capable of dyeing every shade, from the palest rose to the cherry red. It is therefore requisite, before the flowers can be made available, to separate the useless from the valuable colour, and, since the former only is soluble in water, this operation is a matter of little difficulty. The flowers are tied in a sack and laid in a trough, through which a slender stream of water is constantly flowing, while, still further to promote the solution of the yellow colouring matter, a man in the trough treads the sack, and subjects every part to the action of the water. When this flows without receiving any yellow tinge in its passage, the washing is discontinued, and the safflower, if not wanted for immediate use, is made into cakes; these are known in commerce under the name of stripped safflower. It is principally used for dyeing silk, producing poppy-red, bright orange, cherry, rose or flesh colour, according to the alternates employed in combination. These are alum, potash, tartaric acid, or sulphuric acid.

Safflower is grown, but to a limited extent, in Bengal, and does not grow promiscuously all over the district. It is cultivated mostly in the tract of country between the Ganges and the Dhulleseray. Six seers of seeds are required to sow one beegah of land, which under favourable conditions will yield about ten seers of flower. The time for sowing is October and November, and the plucking commences in March and April, when the petals of the flower assume a deep orange colour. After being kept saturated in water for one night the flowers are trodden upon by the ryots the next morning. This is repeated for a few days until the impurities are drained off, and the pulpy substance is then divided into cakes and dried in the sun. This process of dividing them into small portions is done by women, who are occupied by it till a late hour of the night. It is a most profitable source of industry, for, besides the sale of the flowers, the returns from which are very handsome considering the trouble and outlay expended on it, a certain kind of oil is pressed out of the seeds which answers remarkably well for culinary as well as other domestic purposes. The seeds are also consumed by the natives when cooked in milk and sugar. As potash forms the preponderating element in the leaves and stalks of the plant, its ashes are used as a substitute for soap by the common people.

Poultry fatten on the seeds, which somewhat resemble those of the sunflower. The seeds, which are called in India curdee seeds, contain about 28 per cent. of oil. They are imported into this country among other oil seeds. The marc, or oil cake, is given to cattle.

Safflower, once one of the great staples of Eastern Bengal, was a

sure source of income to the ryot. Land subject to annual inundation is best fitted for the plant, and if it has remained fallow for a time the crop gives a good return for three years. The yield is good in the first year, and then somewhat less and less. The soil is then given up, and rotation practised, as the crop is exhaustive. After ploughing, the seed, about four or five seers in weight, is either sown broadcast or put into the ground by means of pressure with the finger. The field is divided into compartments in order to enable the ryot to go on with weeding. Rain, when the tree is a foot high, does it good, but after the appearance of the flower rain injures it, and washes away the colour. One beegah yields about 1 maund 10 seers of flower, the price being about Rs.105 per maund of 82 tolahs—10 annas to the seer.

The flower, after being gathered in, is trodden down in mats in order to expel the viscid juice which it contains, and then taken to the river and washed for three days three times; the more the flower is washed, the better is the colour, river water being preferred to tank water. This substance is then made up into flat cakes, about a dollar in shape. Males and females both work alike at the manufacture. The stalks of the plant are used as firewood. When the stalks are burnt they supply a potash for bleaching cloths.

The plant flowers in three and a half months, and the flowers mature in about fifteen days. Thus the produce of seed sown in December is gathered at the end of March, while the flowers of plants sown a month later are not plucked till the end of April. The corollas only of the flower are gathered, as they mature after intervals of two or three days, and the pluckings take place generally four or five times. The first flowers are generally undeveloped, and, being deficient in colour, yield dye of an inferior quality. The last pluckings are also inferior, as the plant is then old and dried up, and the colour often entirely void of that deep crimson which is so much valued. The operation of plucking is principally carried on by women, who are often employed in this manner for eight hours a day and receive two annas (3d.) for each day's work. Some skill and much attention are required to ascertain when the flowers are ready for plucking, and a sufficient number of hands must be employed to gather all the matured petals in one day, otherwise the colouring matter will be injured by delay, and indeed may eventually vanish altogether. The corollas of the flower when gathered are placed on a mat in the shade and kneaded with the feet for about an hour on the evening of the day they are plucked, and then left for the night in baskets, no water being used on the first day. Next morning they are placed on a mat so arranged as to allow the water to run freely away, while one man kneads the mass with his feet and another pours clean water on it. Filtered water is best for the purpose; but, if this is not attainable, the water must be allowed to stand in vessels for twenty-four hours before it is used. Muddy water often spoils the colour. After being worked up in this way for about two hours, the pulp is again placed in baskets and sprinkled

with water, so as to keep it moist until the afternoon, when it is again kneaded in the manner above described for two hours, and quantities of clean water poured on it. To make good cakes this kneading process must be repeated morning and evening for three days, and the pulp, which is thus kneaded six times, kept thoroughly damp day and night in the interval, and never allowed to dry. The chief components, combined with the woody fibre of safflower, are:—(1) a glutinous substance; (2) a yellow colouring matter, and (3) a red colouring matter. The first two are readily soluble in water, but not so the third, which, however, is small in proportion to the two others. This repeated washing and kneading of the pulp gets rid of the valueless and easily soluble compounds, and the importance of this object readily explains how the great art of making good safflower lies chiefly in the manufacture. To prove whether the pulp is ready to be made into cakes, it must be placed in clean water, so that any discolouration can at once be detected, and when it will no longer yield colour to the water it is fit to use. The cakes of safflower are made round by squeezing the pulp well between the palms of the hands; they should be about $1\frac{1}{2}$ inch in diameter, and about $\frac{1}{8}$ inch to $\frac{3}{8}$ inch thick in the centre, and tapering to the edges. Large cakes are very brittle, and hence small cakes are preferred by the purchasers. The cakes are placed on mats in the sun to dry for three or four days, and are then ready for sale. While the cakes are being dried, rain or damp cloudy weather is very injurious to the colouring matter, and the drying process takes a longer time. As moisture discolours the cakes, they should be kept in jars or other dry covered receptacles. After the petals are plucked, as above described, the plants are allowed to stand for about three weeks to allow the seed to mature, and are then uprooted or cut down and spread out in the sun to dry. When sufficiently dried, the plants are beaten with sticks; and the seed, which is easily separated by this process, is winnowed and made into oil, which is used for lighting and cooking, as well as medicinally in rheumatic and paralytic complaints.

Safflower is cultivated in France and the more southern parts of Europe, both broadcast and in drills. There is a very important diversity, however, in the mode of manufacturing the dye. In France the flowers are picked by hand in dry weather, and then carefully dried in a kiln under pressure. In Europe the flower yields two sorts of colouring matter, one soluble in water, producing a yellow dye, of no great beauty, the other resinous, and best dissolved by the fixed alkalies. It is the last that is esteemed so highly, producing a carmine colour, exceeding in beauty and delicacy any that can be obtained even from cochineal. The colour does not stand, however, and is principally employed for imitating upon silk the colours produced by cochineal upon woollen textures.

The cultivation of safflower was formerly a very large industry in Bengal, but the trade is now almost entirely ruined, aniline colours having driven it completely out of the market. In

1868, 32,000 cwts. were shipped to England, and in 1886 only 2000 cwts.

Safflower is no longer of any importance as an export from India. Its last refuge was in China and Japan, where it is extensively used for rouge, now almost the only use to which it is applied outside of India. In India safflower is still on the whole largely used as a dye, beautiful but evanescent; but here, too, the coal-tar colours are gradually driving it out of use. Twelve years ago the exports from India were valued at £40,000; now they have fallen to less than a tenth of that sum.

The flowers are picked off as they appear, leaving the flower-heads on the stalk. All that is detached is the fragile-looking corolla, which issues from the summit of the prickly teethlike flower-head. When these are picked off, their subsequent treatment depends on whether they are to be made up into the safflower of commerce, or whether they are merely to be prepared for dyeing purposes in the country. If the former is intended, the florets are damped in the water and pressed into lumps. A rough strainer is made by stretching a mat on a wooden frame; on this the lumps of florets are laid, and water is slowly poured over them, while a man treads them out with his feet, supporting himself on two sticks as crutches. In this way the yellow colouring matter is eliminated from the flowers, the presence of which would detract from the beauty of the crimson tint for which they are chiefly prized.

Safflower intended for use in the country is not washed in the method above described at the time they are picked. The flowers are simply dried, in which state they are sold by the cultivators.

The dye is obtained from the petals, which contain two pigment principles, viz., safflower yellow, obtained by pounding and macerating the flowers with soda, and safflower red, which is the dye of commerce. The Dacca safflower is the best of India, and ranks next to that of China.

The exports from India have been as follows:—

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	cwts.	£		cwts.	£
1876-77	7,662	30,467	1882-83	2,333	6,449
1877-78	3,698	14,880	1884-85	2,167	8,308
1878-79	4,977	18,671	1885-86	1,898	6,899
1879-80	2,411	18,145	1886-87	2,149	8,381
1880-81	6,675	3,511			

There is not a very large demand for safflower in England. The great centre of its use was Lyons, where it was employed for the colouring of silks and satins.

SAFFRON (*Crocus sativus*).—This is a pretty bulbous plant of the natural order Iridaceæ. It is alike useful in food, industry, and medicine. Although used to a small extent in pharmacy, and as

a dye-stuff, its chief employment is as a condiment, and for colouring liqueurs, butter and cheese.

The number of species is very great, but they may be divided into those which blow in autumn and those which flower in spring. The bulbs grow wild in large quantities on the sides of mountains, and in the valleys of Sicily, Greece, Turkey, Persia, Spain, Portugal, and other countries.

Saffron, either as a medicine, condiment, perfume or dye, has been highly prized by mankind from a remote period, and has played an important part in the history of commerce.

A peculiar preference for saffron as a condiment exists in some countries, especially Austria; Germany, and certain districts of Switzerland. The predilection prevails even in England—at least in Cornwall, where the use of saffron for colouring cakes is still common. Saffron is largely used by the natives of India in religious rites, in medicine, and for the colouring and flavouring of food. As a dye-stuff saffron is no longer employed in this country, having been superseded by less costly substances.

Saffron contains a yellow matter, which, if extracted and dried, is red, but when wet is yellow; it has a bitter taste, is easily dissolved in warm water and still easier in alcohol, also in ether and the essential oils. The colouring matter is about 42 per cent. of the saffron. It is used in the Morocco trade for colouring skins.

The colouring power of saffron is very remarkable; a single grain rubbed to fine powder with a little sugar will impart a distinct tint of yellow to ten gallons of water.

This plant grows wild in many countries, and is cultivated in several, such as Austria, Hungary, Russia, Greece, Italy, Asia Minor, Egypt, France, and Spain. The two principal countries of production are the arrondissements of Pithiviers (Loiret), in France, and the province of Avignon, in Spain.

The production in France was estimated in 1862 at 33,000 lbs., the greater part of which was sent to Germany, the price being about 75 francs the kilogramme, or a total value of 1,000,000 francs, equal to £40,000.

The production of saffron in France is chiefly confined to three departments, Vaucluse, Charente, and Loiret, of which Pithiviers in the latter produces the largest amount and of the best quality. A saffron field is not in full bearing till the end of the second year; at the end of three years it is exhausted, and, according to a local proverb, the land is then so poisoned that it cannot be used for the same purpose for 15 or 16 years more. The average crop of the second and third year varies, from 10 to 30 kilogrammes per hectare, or from 9 lbs. to 27 lbs. per acre of dry pistils. Each acre produces 600,000 to 700,000 bulbs, and each bulb two or three flowers. About 150,000 flowers are required to produce 2 lbs. of fresh pistils, which, when dried, are reduced to one-fifth of that weight; the pistils are the only productive part of the flower, the rest is waste. The labour of picking such enormous quantities of flowers by hand is great, and when the crop is large and labourers are scarce, the flowers are carried into the

villages and small towns round about, to be picked by women and children at home. In such cases all the world is busy saffron-picking; artisans, shopkeepers, gentlemen, and ladies, freely assist in the work, the poor working for their own profit, the rich for the benefit of the necessitous. When the pistils are separated they have to be dried, and this operation is effected by placing about a pound of fresh pistils at a time in a horsehair sieve, suspended over a little charcoal furnace. As soon as it is dry the saffron is ready for sale. Commercial travellers generally buy up the saffron, which goes by the name of the most famous district, the old province of Gâtinais, principally for Germany, where it is said to be mixed with Spanish saffron and resold as a German product.

The following is an analysis of a good saffron-growing soil in the neighbourhood of the town of Pinseaux, in the celebrated district of Gâtinais:—

Quartzose sand	0·268
Silica and alumina	0·279
Oxide of iron	0·020
Carbonate of lime	0·370
Water and organic matters	0·063
Total	1·000

In the Midi the culture of saffron is only carried on in the department of Vaucluse; but the quality, although appreciated, is considered inferior to that of the ancient French province of Gâtinais. There has long been a large commerce in saffron carried on at Marseilles.

The small yield, the care required in the culture, and the difficulties of preserving the product in a good state renders saffron an expensive article.

Many reasons, especially cheaper labour and the rent of land, and the absence of frost, have enabled the Spaniards to extend the culture, so that it is ten times larger than in France.

The introduction of the species *Crocus Hausskrechtii* from Persia has been recommended of late.

The production in Spain is about double that of France, and, adding the growth of other countries, the value of the saffron produced must exceed a quarter of a million sterling.

In Sicily and in a number of the provinces of Southern Germany, saffron is planted with care in gardens, and when brought to perfection fine results are obtained in the shape of good colouring material. Under culture it rapidly thrives, and it is from these sections that a large amount of the saffron used in the arts and manufactures is obtained. On the seed-bearer of the flower there is a thread-like hook or fork, which at its upper end terminates in three thick dark orange-coloured nerves or masses; to save and collect these tissues the flowers are gathered in the fall, just as they are breaking or a little before; they are plucked only in the morning, and these little masses are then pulled out with a considerable portion of a thread-like stem to which they

adhere. It is the dried stigmas, the trifid orange-coloured tops of the central organ of the flower. The remainder of the flower is useless. The next operation is to dry them in a graduated heat; stoves are made on purpose for this; the heat must be applied gradually.

Saffron, as it generally comes into the trade, consists of a large number of crooked and mixed up threads, of a rather whitish colour; if of a very good quality it has a peculiarly sharp, rooty, and pungent smell, and a bitter balsam-like taste. There are a number of varieties, the Oriental from Asia, the Asiatic from Turkey and other sections of the East. Since its price has risen in the market there have been numerous methods of adulteration invented; these occur, for the most part, in the saffron sold in France, Bavaria, and Austria. The Italian saffron is paler; it, however, dyes a very good colour. The English saffron is always very dry, and is easily pulverized, and therefore is poorer. The poorer saffron comes from Spain, and is made heavy by the introduction of a fatty oil. This can be easily distinguished by rubbing a quantity between the fingers, when an oily feeling is noticeable, which is never present in the pure saffron that has not been tampered with.

Mr. Henry Groves, in giving an account of saffron culture in the Abruzzi district of the Apennines, states that adulteration is carried out in various ways, the chief one being by mixing with it shredded beef, of which a suitable piece is boiled, and then shredded into small fibres, which are stained with saffron water and then dried. The filaments of the stamens are also dyed in the same manner and intermixed. To make the saffron water about 15 grammes of the stigmata are tied up in a cloth and soaked with a little water or wine, which after a time is pressed out, and the process repeated as long as any colouring matter remains. The exhausted saffron is used by the country people in their polento, to which it imparts some slight flavour.

One of the richest centres of cultivation of the crocus is Safranboly, in the vilayet of Kastamouny, in the province of Anatolia, near the ports of the Black Sea, and therefore not far from Constantinople. Its prosperity is entirely owing to the growth of saffron. The bulbs are transplanted in April; they multiply very rapidly, and in three years' time yield an abundant crop in autumn, which fetches about 65 francs per lb. It is frequently met with in a sophisticated state, owing to its high price; indeed, according to Pereira, it takes nine flowers to make up a grain of marketable saffron, so that it does not require less than 4320 flowers to yield one ounce. Some assert that to produce 1 lb. of dry saffron 107,520 flowers are necessary; while others put the quantity as high as 203,920 flowers. According to Dumesnil (*Acad. des Sciences*) 7000 to 8000 flowers are required for yielding $17\frac{1}{2}$ oz. of fresh saffron, and this weight is reduced to one-fifth by drying. The adulteration is effected by the admixture of safflower, marigold, or slices of the petals of the pomegranate.

Saffron of an excellent quality is produced in the Regency of

Tunis. The culture is carried on about the town of Tastus, but only on a small scale. Saffron is grown in China and Japan, and the mountains of Cashmere, but it is not the same species as that grown in Europe. About 250 cwts. of saffron are imported annually into India.

TURMERIC.—This dye-stuff is the produce of the rhizomes of *Curcuma longa*. These, as entering into commerce, differ materially in their exterior form, and have hence been attributed to different plants, but they are all the produce of *C. longa*. Messrs. Fluckiger and Hanbury, in their 'History of the Principal Drugs,' give a good definition of the two sorts of rhizome which enter into commerce, the central or round, and the lateral or long. "The former are ovate, pyriform or sub-spherical, sometimes pointed at the upper end, and crowned with the remains of leaves, while the sides are beset with those of roots and marked with concentric ridges. The diameter is very variable, but it is seldom less than three-fourths of an inch, and is frequently much more. They are often cut and usually scalded in order to destroy their vitality and facilitate drying, as they are exposed to the sun for three or four days.

"The lateral rhizomes are sub-cylindrical, attenuated towards either end, generally curved, covered with a rugose skin, and marked more or less plainly with transverse rings. Sometimes one, two, or more short knobs or shoots grow out on one side. The rhizomes, whether round or long, are very hard and firm, exhibiting when broken a dull, waxy, resinous surface, of an orange or orange-brown hue, more or less brilliant. They have a peculiar aromatic odour and taste.

"Several varieties of turmeric, distinguished by the names of the countries or districts in which they are produced, are found in the English market; but although they present differences which are sufficiently appreciable to the eye of the experienced dealer, the characters of each sort are scarcely so marked or so constant as to be recognisable by mere verbal description."

China turmeric is the most esteemed, but it is seldom to be met with in the European market. A good deal is imported from Takow, in Formosa, to Chinese ports.

The plant is largely grown in many districts in India, but more as a spice used in native cooking than for use as a dye. Native cultivators distinguish several varieties; of the two commonest, the root of one when cut has a rich unctuous appearance, and this is the one which is employed for dyeing purposes; the other has a harder and dryer root, and is only used as a spice in cooking vegetables and meat.

When the soil has been well ploughed and cleared of weeds, it is raised according as the rains begin to fall, into ridges 9 or 10 inches high and 18 or 20 broad. Cuttings or sets of small portions of the fresh roots are planted on the top of the ridges at about 18 inches or 2 feet asunder. One acre requires about 900 such sets, and yields in December and January about 2000 lbs. weight of fresh root.

When dug up the roots are boiled and dried in the sun; in this form they are the turmeric sold in the Indian bazaars. When the dye is to be used, the roots are again boiled and powdered while wet. A decoction is then made of this paste in water, in which the cloth is well steeped, being subsequently dried in the shade.

No satisfactory statistics have been collected concerning the area on which it is grown, or the total annual production. But the quantity exported is shown in the Indian official returns. The well-known haldi is the powder of the rhizome or root-stock, which constitutes the chief ingredient in curry-stuffs.

Turmeric is cultivated all over India for its rhizomes, which are used as a condiment in cooking vegetables and meat. They are also used as a yellow dye, the colouring principle being known as curcumin, which is soluble in alcohol or ether, and changes with alkali into a deep red.

Turmeric is classed as a dye and is largely used for that purpose in Europe, it is also said to be used to adulterate mustard.

EXPORTS of TURMERIC from INDIA.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	cwts.	£		cwts.	£
1880-81	89,256	46,686	1884-85	75,845	73,695
1881-82	67,503	34,696	1885-86	156,257	139,467
1882-83	59,041	34,209	1886-87	140,994	103,202
1883-84	71,396	62,242	1887-88	162,516	93,038

The shipments were made to the following countries in the two last-named years:—

Countries.	1887.	1888.
	cwts.	cwts.
United Kingdom	74,188	90,779
France	24,935	21,201
United States	2,956	10,735
Other countries	38,915	39,801
	140,994	162,516

Madras turmeric is a fine sort, in large bold pieces, called "fingers." Sometimes packages of it contain exclusively round rhizomes, while others are made up entirely of the long or lateral. Bengal turmeric differs from the other varieties chiefly in its deeper tint, and hence is the sort preferred for dyeing purposes.

Java turmeric presents no very distinctive features; it is dusted with its own powder, and does not show when broken a very brilliant colour.

Cochin turmeric would seem to be the produce of another species of *Curcuma*. It consists exclusively of a bulb-shaped rhizome of

large dimensions, cut transversely or longitudinally into slices or segments. The cortical part is dull brown; the inner surface is horny, and of a deep orange-brown, or when in thin shavings of a brilliant yellow. The entire rhizomes are thick, short, conical, and of enormous size, some attaining as much as $2\frac{1}{2}$ inches in diameter.

..... The *Curcuma longa* grows wild in the province of Mysore, and is probably indigenous to various other parts; it is cultivated very generally in most districts of India. It thrives well in a rich light soil, and is readily increased by offshoots from the roots.

It is chiefly used in Europe as a dye-stuff, and the powder affords without a mordant a yellow dye, which is brilliant but not permanent. It is largely used by native females in India to colour their faces. Mixed with the pulverised sappan wood it forms the red powder used by the Hindoos, under the name of *faug*, in the Huli festival games. It is extensively used in cooking in the East, especially as an ingredient in curry powder; indeed, there are few articles of food that are not there flavoured with turmeric.

It used to be used medicinally in this country, and maintains a high reputation among native practitioners in the East as a cordial and stomachic, as anti-scorbutic, and stimulating the digestive organs. It is frequently given in the fresh state as an anthelmintic, and in diarrhoea.

CUTCH.—Perhaps less is known in commercial circles of the history and origin of the inspissated extracts known as Cutch and Gambier, which are now imported to so large an amount for tanning and dying purposes, than of any other products. The misnomer of “Terra Japonica,” which was so long applied to gambier in the official trade returns, has now been got rid of, and the two extracts appear under their proper names. Although they are frequently confounded by many, cutch and gambier are obtained from different sources and different plants. It may, therefore, be well to give some detailed description of them, and of the great progress they have made, until our imports of these two products now reach a value of about £700,000.

The cutch of commerce is obtained chiefly from two species of *Acacia*. The common name, catechu, under which it sometimes passes, is derived from *Cate*, a tree, and *chu*, juice. It is usually called in India kath or kut. Perhaps the best-known use of kath is as an ingredient in the prepared *pan* leaves, generally chewed by the natives of India. The kath is pounded fine, and a little is then smeared on the pan leaf, together with some lime and crushed betelnuts. It is the *kath*, in combination with the lime, which gives to the teeth and lips the red colour so unsightly to European eyes; 3000 to 4000 cwts. of catechu are exported from the Kumaon forests. The trees from which it is prepared are chiefly: (1) *Acacia Catechu*, Willd.; *Mimosa Sundra*, Roxb., a tree 30 or 40 feet high, with dark-grey or brown bark, reddish and fibrous internally. This tree is common in most parts of India and Burmah, where it is highly valued for its wood, which is used for

posts and for various domestic purposes, as well as for making catechu and charcoal, while the astringent bark serves for tanning. (2) *A. Suma*, Kurz.; *Mimosa Suma*, Roxb., a large tree, with white bark, nearly related to the preceding, but not having so extensive a geographical range. It grows in the south of India (Mysore), Bengal, and Guzerat. The bark is used in tanning, and catechu is made from the heart-wood, but not so extensively as from the former species. The process for preparing it varies slightly in different districts. The tree is reckoned to be of proper age when its trunk is about a foot in diameter. It is then cut down, and the whole of the woody part, with the exception of the smaller branches and the bark, is chopped into chips. Some accounts state that only the darker heart-wood is thus used. The chips are then placed with water in earthen jars, a series of which are arranged over a mud-built fireplace, usually in the open air. Here the water is made to boil, the liquor, as it becomes thick and strong, being decanted into another vessel, in which the evaporation is continued, until the extract is sufficiently inspissated, when it is poured into moulds made of clay, or of leaves pinned together in the shape of cups, or in some districts on to a mat covered with the ashes of cow-dung, the drying in each case being completed by exposure to the sun and air. The product is a deep reddish-brown extract, with a glassy fracture, which is the usual form in which cutch is known in Europe. In Kumaon, in the north of India, a slight modification of the process affords a drug of very different appearance. Instead of evaporating the decoction to the condition of an extract, the inspissation is stopped at a certain point, and the liquor allowed to cool, coagulate, and crystallise over twigs and leaves thrown into the pots for the purpose. By this process there is obtained from each pot about 2 lbs. of "kath," or catechu, of an ashy whitish appearance. This product is brought down from Berar and Nepal to Calcutta, but not exported. The cutch of Pegu has a high reputation. Catechu contains about 50 per cent. of tannin. It is used by dyers, not as a dye-stuff, however, but as a source of tannic acid, which it contains in a very large quantity, and this has the property of forming, with a solution of a salt of sesquioxide of iron, an exceedingly deep, bluish-black liquid (ink). Catechu is used also in medicine as an astringent, on account of the large quantity of tannic acid which it contains.

According to some accounts cutch, or catechu, is prepared thus: The tree is cut down to about 6 to 12 inches from the ground, and the inner wood chopped into small pieces, the smaller branches and bark being rejected. The chopped wood is then taken to the place of manufacture, generally under trees in the open air, and placed over a brisk fire in mud jars, called *garrahs*, filled with about two-thirds of water. This is allowed to boil down, till; with the extracted matter, it forms a liquid of syrupy consistence. The contents of several jars are then poured into a larger jar, and this is placed over a brisk fire for a period of from two to four hours, and, when sufficiently boiled down, it is poured out over mats and allowed to dry. The wood when dry is used for fuel.

In Burma and Bombay the decoction is boiled down to a solid consistence and thrown into leaf moulds, or is baked into cakes and balls. This is the ordinary cutch of commerce.

This substance is apparently rarely, if ever, exported from India, but may be procured from Madras and Mysore, where a considerable local trade is done in this form of cutch. It exists in large slabs about an inch in thickness, prepared on the leaves of the Teakwood tree.

Other kinds of catechu are prepared in India. The commonest kind is palm cutch, from the nut of the *Areca Catechu*. The nuts are boiled for some hours in an earthen or tinned copper vessel, which furnishes the astringent extract called kossa, which is black, and mixed with paddy husks and other impurities. After the nuts are dried, they are put into a fresh quantity of water and boiled again, and this water being inspissated like the former, yields the best kind of catechu, called cooney. It is yellowish-brown, has an earthy fracture, and is free from the admixture of foreign bodies.

The betelnuts are prepared for use in various ways. They are boiled, and when the water has become red and thick the nuts are taken out, cut in slices with a simple lever cutter, and dried in the sun; they are then once more steeped in the liquid and again dried. From the decoction of the nuts two kinds of catechu are obtained: one, called cattacumboo, is used as a masticatory chewed with the betel leaf; the other, called cash cuttie, is used medicinally as an astringent.

The collection and preparation of the betelnuts are described under the head of the Betelnut Palm, p. 286.

The imports of cutch into the United Kingdom are about 6000 or 7000 tons. British India supplies the largest portion.

The total exports from India have been as follows:—

				Cwts.					Cwts.
1885	..	..	..	246,122	|	1887	..	..	199,397
1886	..	..	..	205,355	|	1888	..	..	273,068

GAMBIER.—The gambier plant is a stout, climbing shrub, a native of the countries bordering on the Straits of Malacca, and especially of the numerous islands at their eastern end. There would appear to be two species employed:—(1) The *Uncaria Gambir*, Roxb.; the *Nauclea Gambir* of Hunter. (2) *Uncaria acida*, Hunt. The cultivation and manufacture seem to have been commenced at Singapore in 1819, and it rapidly extended until there were about 600 or 800 plantations; in 1866 the cultivation was fast disappearing on the island. Of late years, owing to an increased demand for the product, and higher prices ruling, it has rapidly recovered. The culture is also largely pursued on the mainland. In the islands of the Rhio Linga Archipelago, lying south-east of Singapore, and on the Island of Bintang, the most northerly of the group, there are many gambier plantations. The plant is propagated either by seeds or cuttings, but the latter are preferred. At the expiration of fourteen months the first cutting of the

ANNOTTA, OR ARNATTO.—The culture of the large shrub producing this dye-stuff is chiefly carried on in the French colonies of Guadeloupe and Guiana, where it is known as *roucou*, and in other parts of South America as *achiote*. It is washed off from the seeds of a small tree or shrub, the *Bixa orellana*, a native of the warm parts of South America, the East and West Indies, and Africa. The plant is grown in the Deccan and other parts of India and the Eastern Archipelago, in the Pacific Islands, Brazil, Peru, and Zanzibar. The fruit is like a chestnut, a two-valved capsule covered with flexible bristles, and contains a certain number of seeds smaller than peas. These seeds are covered with a soft, viscous, resinous pulp, of a beautiful vermilion colour, and unpleasant smell like red lead mixed with oil, and it is this substance which constitutes annotta. The mode in which it is obtained is by pouring hot water over the pulp and seeds, and leaving them to macerate, and then separating them by pounding them with a wooden pestle. The seeds are removed by straining the mass through a sieve; and the pulp being allowed to settle, the water is gently poured off, and the pulp put into shallow vessels, in which it is gradually dried in the shade. After acquiring a proper consistence it is made into cylindrical rolls or balls, and placed in an airy place to dry, after which it is sent to market. It used to be most common in the form of small rolls, each 2 or 3 ozs. in weight, hard, dry, and compact; brownish without and red within. Roll annotta is of an inferior quality, containing less of the colouring matter; is hard, dry, and compact, of a brownish coloured exterior, but a bright red interior. The rolls come principally from Brazil. The flag annotta fetches double the price of roll. The other process of manufacture is that pursued in Cayenne. The pulp and seeds together are bruised in wooden vessels, and hot water poured over them; they are then left to soak for several days, and afterwards passed through a close sieve to separate the seeds. The matter is then left to ferment for about a week, when the water is gently poured off, and the solid part left to dry in the shade. When it has acquired the consistence of solid paste, it is formed into cakes of 3 or 4 lbs. weight, which are wrapped in the leaves of the banana, and known in commerce as flag annotta. This variety is of a bright yellow colour, rather soft to the touch, and of considerable solidity.

Labat informs us that the Indians prepare an annotta, greatly superior to that which is brought to us, of a bright, shining red colour, almost equal to carmine. For this purpose, instead of steeping and fermenting the seeds in water, they rub them with the hands, previously dipped in oil, till the pulp comes off and is reduced to a clear paste, which is scraped off from the hands with a knife, and laid on a clean leaf in the shade to dry. Mixed with lemon juice and gum, it makes the crimson paint with which the Indians adorn their bodies; and they employ the leaves and roots in cookery to increase the flavour and give a saffron colour.

It owes its value to the colouring matter bixin and orellin, which constitute about 20 per cent. of good dry annotta. Fresh annotta contains more than half its weight of water. It was formerly employed in dyeing wool and silks, but its colour, though beautiful at first, soon fades, and hence it has been abandoned for more permanent dyes.

Annotta is principally consumed by painters and dyers; but it is also used to colour cheese with a pale yellow or flesh colour. The Dutch use it for heightening the colour of their butter, and it is employed for the same purpose in some American and English dairies.

In French Guiana there are 850 acres devoted to it, which produced, in 1885, 74,500 kilos. In Guadaloupe there are seven planters who have 1400 acres under culture; the produce, in 1883, was 700,000 kilos., and in 1885, 1,100,000 kilos. It thrives in this island at an altitude of 400 to 500 yards.

Annotta bears twice a year, the spring blossoms always yielding the largest crop. As soon as the pods in the bunches commence drying and opening, the bunches are cut by means of a pair of shears or a crooked knife. These bunches are packed in baskets and transported to the shed prepared for the purpose. Every pod requires to be picked with the hands, the seeds attached to the white film inside being as much as possible untouched. The crop is gathered from the 15th of July until the end of August, and it is estimated that one hectare ($2\frac{1}{2}$ acres) should yield on an average 3500 lbs. of seeds for the two crops, or about seven casks of pulp, weighing from 350 to 400 lbs. each.

For many years this dye-stuff was in demand for dyeing, and proved profitable when the culture was carried on on a large scale, but the aniline colours have lessened the demand. Still, many thousands of pounds are exported from the two islands of Martinique and Guadaloupe.

Some ten years ago, only 25,000 lbs. of annotta used to be exported from Jamaica, but the shipments have largely increased, having been in—

Year.	Quantity.	Value.
	lbs.	£
1885	268,187	3,602
1886	369,284	7,693

About 130,000 lbs. are shipped from Brazil, and 39,000 lbs. of annotta were received from the Congo State, Africa, in the third quarter of 1887.

Onoto, as it is there termed, is abundant in Venezuela; in the eastern part of the State it is known locally under the name of caituco. There is a variety with larger fruit and smaller spines than the common one.

Annotta is disseminated throughout the island of Porto Rico

and is there of spontaneous growth, for there is no instance of any regular plantation being established. The country-people plant near their homesteads two or three shrubs, for the sake of the fruit, which they use as a condiment in place of saffron or red pepper. A very small quantity is exported, but no other preparation is given to the article than merely drying the pods in a current of air under shelter from the sun, and then packing them in bags or barrels.

HENNA (*Lawsonia alba*, Lamk.; *L. spinosa* and *inermis*, Lin.; *Alcanna spinosa*, Gaert.).—This plant grows plentifully in Egypt and in most parts of the East, as far as India. From the leaves a paste is compounded with which every Eastern beauty colours her hands and feet. Nay, so ancient is the custom, that mummies have been found with their nails dyed with henna. In later times, Mahommed used henna as a dye for his beard, and the fashion was followed by several of the Caliphs. The use of henna is scarcely to be called a caprice in the East. There is a quality in the drug which gently restrains perspiration in the hands and feet, and produces an agreeable coolness, equally conducive to health and comfort. It forms an important article of commerce in all the Arabian towns. The production in Egypt is said to exceed 6,500,000 lbs.; 2216 cwts., valued at £3545, were shipped from Morocco in 1873.

Henna is largely used throughout Turkey, Egypt, Syria, Persia, and India, as a substantive dye-stuff. It is but slightly, if at all, soluble in cold water; but warm water, into which a little lime has been thrown, readily dissolves out the colouring matter.

Henna is cultivated on a large scale at Touat; a portion of this region bears the significant name of Henna Touat. The caravans of Sahara supply all the Moghreb with it, and great use is made of the plant as a cosmetic. European industry obtains from it a good black dye.

Henna appears to have been known in India in the time of Arrian, as may be inferred from his statement that the people of India daub their beards white, red, purple and green. It is used by the western Hindoos, and the plant is abundantly cultivated in the vicinity of Bombay. It is generally planted in India in the gardens and fields around houses for the aroma of its flowers. It blooms all the year round, and forms hedges in some places. The leaves are used to dye the hair and skin, and it is also employed to tinge the nails and the skin of the Indian women, especially those of the Mussulman race; it is mixed with catechu. Medicinal properties are also attributed to it, for the natives use it in cutaneous affections, in epilepsy and jaundice.

The Turks and Arabs are very fond of dyeing the manes, tails and hoofs of their white or grey horses of a fine mahogany brown with henna.

Dr. Tholozar, physician to the Shah of Persia, thus describes the mode of employing henna for colouring the hair in Persia:—Hot

water is added to a coarse powder of the leaves, and the paste is applied to the beard, the hair, and the nails (well washed previously). This is done in a vapour-bath. As the paste has to be kept constantly moist, this first application lasts an hour and a half to two hours; then the parts are washed with plenty of water. The henna gives an orange-red colour, very beautiful on a white beard, so that many old men use it; but recently, with great personages, it has become more common to keep the beard white. Henna is very largely used, even by peasants. To change the reddish colour to a very fine lustrous black, the parts are coated, at the same sitting, with a paste formed of another powder—that from the leaves of a kind of indigo cultivated in Persia. This is called reng; it remains applied about two hours. The henna gives different colours, according as it acts on white, fair, or dark hair. It alters very quickly in moisture, and loses its properties in long sea voyages. Experience seems to have proved that it gives suppleness to hair, but it causes it to whiten much sooner than usual. Fair-haired people always colour their hair black, but the black is not so intense as that produced in persons of dark complexion. Skin, reddened and blackened with the two pastes, soon regains its natural colour on being washed with soap and rubbed with the fingers, whereas the dye adheres firmly to the hair, which it penetrates. Reng is sometimes used alone, and gives a blue-violet colour.

Henna has been known from antiquity, and sought for the perfume of its flowers. These are employed to scent the oils and pomades used to anoint the body and give it suppleness. It was also used for embalming, as the heads of flowers have been found in mummy cases. The ancients prepared with the leaves a powder called Archenda, now known as henna. The females use it to improve their appearance, and to colour their hands, feet, and nails of a rose-orange, a custom formerly very extended, but which is not now so fashionable in the East.

Some botanists enumerate two species, *L. inermis* and *L. spinosa*, while others hold that, although the leaves of the former are larger than those of the latter, they are both the same species, in spite of one bearing thorns and the other not. The best henna comes from Mecca, and is brought to Constantinople by returning pilgrims. In general appearance it closely resembles the common privet. It is propagated by cuttings planted in shady situations, and is a fast-growing shrub; when the shoots reach the length of about 3 feet, they are cut with a sickle and stripped of their leaves, which are dried in the sun and finely powdered in a kind of rude hand-mill. In about two months or so, when a fresh set of shoots have reached the proper size, a second gathering is made, each plant yielding two or even three crops a year. If the plant is cultivated for the sake of the flowers, the shoots are allowed to grow to the length of 5 or 6 feet before they are cut. The fresh flowers, which give out a delicious odour, have been sold in the streets of Alexandria and Cairo from time immemorial.

ALKANET ROOT.—The dark blood-red root of *Anchusa* (*Alkanna tinctoria*), growing on sandy places around the Mediterranean Sea, enters into commerce to a small extent. It is insoluble in water, but soluble in alcohol, ether, and bisulphuret of carbon. It is not at the present day employed as a dye-stuff, its chief use being in pharmacy to colour medicines; in perfumery to colour oils and greases, to stain woods, and to give a tint to the lime-wash used for the walls of private dwellings.

In China this root is used to bring out the eruption in small-pox and to colour candles.

SECTION V.

THE OIL SEEDS AND VEGETABLE OILS
OF COMMERCE.

GREAT as has been the extension of commerce and the progress of our foreign agricultural supplies, the Oil Seeds of commerce are yet far from commensurate to the increasing wants of Europe. It is therefore a wise provision that new discoveries crop up from time to time, arising from the progress of scientific research, or the extension of foreign agriculture to meet in some measure these increased demands. When the oils yielded by the whale fishery declined, and by their enhanced price became too expensive for manufactures, increased attention was given to the production of vegetable oils and larger quantities of oil seeds for crushing, from Europe, Africa, and the East, were obtained. Even these were found insufficient for the increased demand, till the discovery of the mineral oil springs came in to supply the wants. The vegetable oils, however, provide, and will long continue to do so, the bulk of the consumption.

In the section on "The Useful Palms," some of the chief vegetable oils, such as Coconut oil and Palm oil, have already been described, and I now proceed to notice others.

THE OLIVE.—The olive (*Olea Europea*) is supposed to have been originally a native of Asia, and grows abundantly about Aleppo and Lebanon, but it is now naturalized in Greece, Italy, Spain, and the South of France, where it has been extensively cultivated for an unknown length of time, for the oil expressed from its fruit. The wild olive is found indigenous in Syria, Greece, and Africa, on the lower slopes of the Atlas. The cultivated one grows spontaneously in Syria, and is easily raised on the shores of the Levant. Much attention has, of late years, been paid to olive culture by the French in Algeria. Tuscany, the South of France, and the plains of Spain, are the parts of Europe in which the olive was earliest cultivated. The Tuscans were the first who exported olive oil largely, and thus it has obtained the name of Florence oil; but the purest is said to be obtained from Aix in France.

The olive in the western world followed the progress of peace, of which it was considered the symbol. Two centuries after the foundation of Rome, both Italy and Africa were strangers to that

useful plant: it was naturalised in those countries, and at length carried into the heart of Spain and Gaul. Its usefulness, the little culture it requires, and the otherwise barren situations which it renders productive, quickly spread it over the western face of the Apennines. According to Humboldt the olive is cultivated with success in every part of the old world where the mean temperature of the year is between 58° and 66° ; the temperature of the coldest month not being under 42° , nor that of summer below 71° . These conditions are found in Spain, Portugal, the South of France, Italy, Turkey, and Greece. The olive also flourishes on the north-west of Africa, but is not found south of the Great Desert, except in parts of the Cape Colony, where it has been introduced or grafted on indigenous species.

In Europe it extends as far north as latitude $44\frac{1}{2}^{\circ}$, in America scarcely to latitude 34° —so much greater is the severity of the winter on that side of the Atlantic. In the neighbourhood of Quito, situated under the equator, at a height of 8000 feet above the level of the sea, where the temperature varies even less than in the island climates of the temperate zone, the olive attains the magnitude of the oak, yet never produces fruit.

Olive oil may be said to form the cream and butter of those countries in which it is pressed; the tree has been cultivated in all ages as the bounteous gift of Heaven, and the emblem of peace and plenty. There is a common saying in Italy that “if you want to leave a lasting inheritance to your children’s children, plant an olive.”

In Italy the young olive bears fruit in two years after it has been placed in the plantation. In six years it begins to repay the expense of cultivation, if the ground is not otherwise cropped. After that period the produce is the surest source of wealth to the farmer.

The exports of olive oil from the two principal producing countries were as follows, according to the latest returns:—

		Kilos.
Spain, 1886	.. .. .	15,049,000
Italy, 1886	.. .. .	64,801,000

We receive supplies from France, Spain, Italy, Turkey, Tunis, Morocco, and other countries.

IMPORTS OF OLIVE OIL into the UNITED KINGDOM.

	Tuns.		Tuns.		Tuns.		Tuns.
1840 ..	8,783	1852 ..	8,898	1864 ..	16,705	1876 ..	23,975
1841 ..	4,734	1853 ..	10,102	1865 ..	32,005	1877 ..	31,271
1842 ..	14,095	1854 ..	12,888	1866 ..	23,690	1878 ..	20,615
1843 ..	12,094	1855 ..	25,449	1867 ..	19,993	1879 ..	26,198
1844 ..	14,962	1856 ..	21,415	1868 ..	17,585	1880 ..	20,260
1845 ..	12,315	1857 ..	18,862	1869 ..	28,240	1881 ..	29,864
1846 ..	8,534	1858 ..	25,121	1870 ..	23,202	1882 ..	23,450
1847 ..	8,692	1859 ..	19,786	1871 ..	38,281	1883 ..	31,053
1848 ..	10,086	1860 ..	20,859	1872 ..	24,025	1884 ..	17,213
1849 ..	16,964	1861 ..	17,325	1873 ..	35,121	1885 ..	24,227
1850 ..	20,784	1862 ..	21,095	1874 ..	22,720	1886 ..	20,664
1851 ..	11,503	1863 ..	19,866	1875 ..	35,453	{ Value £791,245..	

Italy.—The olive tree demands a dry and limy soil ; its introduction into Italy was therefore very successful. The soil of the Apennines, which extend through the whole Peninsula and branch off in all directions, consists mostly of lime, and is very favourable to the growth of the olive tree. We find the stately tree, with its beautiful crown and evergreen leaves, spread over the whole Peninsula where the temperature does not fall below 60°.

The best olive oils of Italy come from Genoa, Lucca, and Tuscany, but excellent qualities are drawn from the Neapolitan country and Sicily. The frullino oils are thick, coloured, and only applicable to industrial purposes, and so are the oils obtained from the residues, which are treated by sulphide of carbon. The fine and ordinary oils are clear, limpid, and of excellent flavour.

The export of olive oil from Italy ranges from 50,000,000 to 92,000,000 kilogrammes annually, according to the crop of olives. In 1874, the produce was 9,310,000 bushels; in 1881 it was only 3,607,667 bushels from an acreage under olives of 2,211,000 acres.

The area under olive culture in Italy is now 2,258,000 acres. The oil production of 1885 was stated to be 3,338,825 hectolitres, divided as follows:—

	Hectolitres.
Southern Adriatic coast province	1,233,434
„ Mediterranean coast province	701,955
Sicily	659,084
Tuscany	253,675

The export of oil amounted in 1884 to 533,774 cwts., and in 1885 was only 359,549 cwts.

The most extensive use is made of the olive. Its harvest begins when scarcely ripe. The green olives are put into a solution of salt; they are kept there for some time, to cause them to lose their natural bitter taste, then carefully preserved in vinegar, mixed with different spices, and sold in bottles or small barrels. Those of Tuscany and Lucca are considered the best, on account of their light green colour and strong flesh. In all parts of southern Europe they are, in this form, a daily food.

The treatment of the ripe olive is more important. They are gathered in the fall, when they are as large as common plums; their colour is dark green, and the soft kernel has changed into a hard stone, which contains a savoury almond. The flesh is spongy, and its little cells are filled with the mild oil, which pours out at the least pressure.

The olive tree bears about ten pounds of fruit, but in very rich years double that quantity can be gathered. The finest oil is the so-called virgin oil. To obtain the oil no preparation is needed; the freshly gathered olives are put into little heaps, and by their own weight the oil is pressed out, and is caught in some vessel. It is clear, like water, has a delicate nut-like taste, with little or no odour. When the fruits cease to give the oil by themselves, they are pressed with small millstones. The oil gained by this process is also clear and of pleasant taste. After this treatment the olives are still rich in oil, which only demands some work to

draw it out. To accomplish this, the fruits are put into sacks, boiling water poured over them, and they are pressed once more. The oil gained by this process is yellowish green, has a sharp taste, and an unpleasant smell, because it contains some mucilaginous matters. Sometimes the so-treated olives are once more pressed and boiled over; the oil thus obtained is called in France "*huile d'enfer*," and is only used for burning or similar uses. The olives may also be brought to a fermentative process, before pressing them, when they give more oil, but of a less fine quality.

At Marseilles the olive oils are classed into manufacturing oil, for burning or for factories; refined, oil from the pulp or husks; and table or edible oil. The latter is divided into superfine, fine, half fine, and ordinary. The quantity taken for consumption of the different kinds was as follows:—

	1886. Kilos.
Refined oil	5,400,000
Oil of pulp or husks	4,735,000
Manufacturing oil	2,300,000

The Italians keep their oil in stone jars, as did their classic ancestors. The oil for sale is filled into barrels of oakwood imported from Germany. The oil needs always a very attentive treatment. By a long rest some slimy part of it settles at the bottom; these dregs must be removed, or the oil would become rancid; therefore the barrels are tapped every six months, and filled anew. The treatment resembles that of wine, but with this difference, that oils of a fine quality can seldom be kept more than three years.

The oil made in the district of Oneglia is better than that of Southern Italy, and large quantities are refined before being exported. The process of refining the oil is very simple. Large shallow tin boxes are made, with small holes pierced in the bottom; these are then covered with a thin sheet of wadding. Four, five, or more of these boxes are placed on frames, one over the other, and the oil being poured into the top box, is allowed to soak through the wadding and drop into the next box, and so on until it gets into the last, when it runs off into the tanks. The wadding absorbs all the thick particles contained in the oil when it comes from the mills, and leaves it perfectly clear and tasteless. The oil thus refined is almost exclusively exported to Nice, where it is put into flasks, and sent all over the world as "*Huile de Nice*."

Syria.—Olive oil is produced throughout the country, but chiefly on the plains of Safet, Nazareth, and Nablono. The average produce is estimated at about 7000 tons. In 1871 about 1800 were exported, and prices ranged from £60 10s. to £41 10s. per tun. The plantations are being extended principally on the coast line between Latakia and Jaffa, the climate of which is peculiarly adapted for olive cultivation. Nearly half a million of new trees are said to be annually planted throughout the country. The quality of the finer sort of oil is found equal to the Italian, while that from the neighbourhood of Sidon is said to rival the finest

qualities that Europe can produce. About one-half of the oil is consumed in soap-making, one-quarter in eating and burning, and the remaining quarter is exported chiefly to France. The oil press used is the rude native one, and there is but one European press in the country.

The exports of olive oil from Greece were in—

			Ocques.				Ocques.
1871	..	..	9,213,257	1873	..	..	6,381,471
1872	..	..	2,592,543	1874	..	..	2,919,421

Like most other trees that have been cultivated for a length of time, the olive has produced numerous varieties; different countries, and even different districts, cultivating their peculiar favourite.

The variety *longifolia* and its many sub-varieties are chiefly cultivated in France and Italy; the variety *latifolia* and its sub-varieties are those chiefly grown in Spain; the fruit of the variety *latifolia* is nearly twice the size of the common olive of Provence and Italy, but the oil is greatly inferior.

There are several varieties of olive, differing less in their fruit than in the form of their leaves; two of these have been introduced into the Cape Colony, one of them from England, by Mr. Thomas Berry, in the year 1821, and the other variety, I believe, from France, since that period. The European olive can be propagated in various ways. Cuttings of 9 inches in length, taken from one-year-old shoots, may be planted in a rich light soil, and kept moderately moist; the ground ought never to be allowed to become very dry; these will root freely in a few weeks, and be fit for transplanting in twelve months. In Italy the propagation is conducted in the same manner in which it was during the time of the Romans.

“An old tree is hewn down, and the ‘ceppo’ or stock (that is, the collar or neck between the root and the trunk, where in all plants the principle of life more eminently resides) is cut into pieces of nearly the size and shape of a mushroom, and which from that circumstance are called novoli; care at the same time is taken that a small portion of bark shall belong to each novoli; these, after having been dipped in manure, are put into the earth, soon throw up shoots, are transplanted at the end of one year, and in three years are fit to form an olive yard.”* Truncheons, or stakes of the olive, 2 inches thick and 5 feet long, may be driven into the ground where they are intended to remain, and root freely. Shoots of one or two years’ growth may be laid down, giving them a twist to crack the bark; or slit them half-way through, when they root very readily. These operations should be performed in the month of August.

In France and Italy uncertainty prevails in the crops of olives; sometimes one that yields a profit does not occur for six or eight years together; and hence it is considered that the culture is less beneficial to the peasants of those countries than that of corn: but

* Blunt’s ‘Vestiges,’ &c., p. 216.

these circumstances do not appear to apply to the southern colonies, especially as the olive may be cultivated on ground which is impenetrable to the plough or spade.

France.—The olive is grown in twelve departments, all situated in the south; those where it is chiefly cultivated are: Var, Vaucluse, Bouches du Rhône, Gaud, and Alpes Maritimes. The extent of land occupied with this tree a few years ago was 129,143 hectares. The production in fruit amounted to 2,402,610 hectolitres. Allowing from this 15 per cent. for fruit eaten locally, there would remain 2,000,000 hectolitres converted into oil, which produced 260,000 cwts., valued roughly at 36,920,000 frs.

The olive tree is almost the only product of a large portion of the mountainous district of Nice, and yields (where there is no possibility of other produce requiring tillage and husbandry) a small return for the labour bestowed on the trees and the manufacture of the oil. Each little proprietor takes his olives as he gathers them to a mill in small quantities, using it in common with his neighbours, and paying for its use a percentage of his oil, and the refuse of his olives and the oil is taken to market for sale in small quantities, according to the daily produce.

More than 15,000 acres are planted with this tree in Nice, producing on an average 180,000 to 200,000 gallons of oil. The tree grows well even at great elevations above the sea, and will stand 10 degrees of cold; but the produce is uncertain, on account of the length of time which the fruit remains on. The olive tree grows slowly, and yields no crop until it is twenty years old. The olives are collected about December by beating the trees, a mode of treatment that bruises the fruit and injures the quality of the oil; in fact, neither olives nor oil are ever so good as when picked by hand. There are 168 oil mills in the district, 115 worked by water, the others by horse-power. Ten gallons of good olives will yield 1 to 1½ gallons of oil, but the average quantity is about 10 per cent. There are very nearly 800,000 olive trees in the vicinity of Nice, and each tree will give in a good year from 50 to 150 kilos. of olives, according to size.

There are five kinds of olive trees principally cultivated in the south of France, viz., Verdall, which yields good oil, and makes a good conserve; Blanquet yields a particularly sweet and delicate oil (these two have low-growing branches, which enables them to be picked by hand); Bouquettier, a very superior oil; Redouanou, which stands cold well; Olivier de Grasse yields excellent oil, but grows high, and is not so well adapted for picking.

Spain.—According to official statistics a thirtieth part of the whole of the cultivated land of Spain is employed in the growth of olives; the olive cultivation occupying 858,000 hectares (two and a half acres) of the 26,542,030 hectares of land under cultivation. Even in the Balearic Islands, where the cultivation appears to the eye to be so general, one-half of the land actually remains uncultivated. Confining attention, however, to these islands, it would appear that somewhat more than 26,838 hectares are

occupied with the growth of olives, the yearly produce being about 3,152,493 litres of oil, of the gross value of £123,236. No olives are grown in the island of Minorca. The districts of Ivica and Palma are those which give the largest results. The total for the whole of the island shows 1 hectare of olives in every 21 hectares of land under cultivation.

The expenses of culture are considered to amount to about 67 per cent. In land that will admit of ground crops being cultivated under the olive trees the practice is invariably followed. The ancient historians of Majorca recount that in olden times the olive was unknown in these islands, and that the art of grafting was taught to the islanders by the Carthaginians.

The oil is employed for every conceivable purpose, and although the consumption is very great, yet the exports increase year by year. Like the vine, the Spaniards are equally careless cultivators of the olive, and from want of attention the quality of the fruit is injured and the yield of oil reduced. During harvest time there is often a deficiency of labour, and after having knocked down the olives, it is customary to leave them in great heaps, there to shrivel up and ferment until the winter before extracting the oil. This renders the very best oils unfitted for use in the *cuisine* of any other country except Spain, where the tastes of the inhabitants are peculiar. There is no doubt that whenever the extraction of the oil is made at the proper season, and precautions are taken to avoid rancidity, there will be obtained in Spain oil equally good for the table as that procured even in Provence.

In countries where more care is exercised in the preparation of olive oil than is displayed here, the "virgin oil" obtained from the fruit when first pressed is carefully separated, as being of a better quality than that which is procured by the application of hot water to the bruised fruit, and by the application of greater pressure. But the quantity of virgin oil produced in these islands is quite insignificant, although it is of excellent quality. All the oil that can be squeezed out of the olives by means of the antiquated machinery still in use, is generally poured into one common tank and left to clarify as best it may; or, at most, the olives are roughly sorted, the inferior ones being made into oil for the soap-boilers. The fruit, whether ripe, over-ripe, half-green, or wholly rotten, or whether it may have been knocked down by the beaters' canes, or blown down by the wind and rain in stormy weather, and trodden underfoot, is too commonly all picked up about one time by the women and children who are employed at the gathering season. It is then, after being sorted or not, as the case may be, crushed under the millstone, and the oil drawn by the application of boiling water. The refuse of the olives after the last crushing, which is far from getting out all the oil contained in the pulpy mass, is used to feed the fires required to boil the water. Probably nowhere may be seen more magnificent olive trees, or better olives, than those grown in these islands; but the oil, from being unrefined, is often acrid in taste and inferior to that of other countries.

Algeria.—The climate here is especially suited to the olive, which grows spontaneously at all points of the three provinces. According to the latest details there are over 3,000,000 olive trees, the half of which are grafted. It may be remarked here that though the fruit of the grafted tree is larger and more fleshy, and contains therefore more oil, that of the wild olive tree yields a finer and pleasanter kind. The production of oil is increasing yearly, and there are improvements noticeable in its quality. The province of Constantine furnishes annually about 150,000 hectolitres, of which one-third is exported. And although there are no precise details as to the other two provinces, the production in these is equally considerable. 4,648,000 kilos. of olive oil, valued at £221,000, were exported from Algeria in 1887.

Morocco.—The olive gardens of the south form picturesque groves of great extent. Their produce constitutes the principal wealth of the provinces of Haha and Sus. But the oil, probably from the imperfect methods of preparing it, is greatly inferior to that of Spain and Italy. It is, however, exported from Mogador in large quantities.

Tunis.—Susa, Monastir, Media, Sfax, and Biserta are the best olive districts in the Regency, there being at the former place upwards of 4,000,000 trees, and if the cultivation were more energetically attended to double the crops could easily be produced. The olives are gathered in December and January, the pickers using leather coverings to the fingers. There are two kinds of oil, the “masri,” strong in flavour and smell, and the “drup-el-ma,” which is deprived of both by being passed through water.

LINSEED OIL is obtained from the seed of the flax plant (*Linum usitatissimum*), formerly called lint-seed. We used to obtain almost all our supply of this seed from Russia, but now we get a good deal from India. Of the imports in 1875, 369,163 quarters came from India, and the rest from the Continent, chiefly Russia. The aggregate value of the seed received was £4,675,242. As a general rule, the colder the climate in which the seed is grown the greater are the drying properties of the oil, although it is not so good in colour. The East Indian seed is much mixed with rape and other seeds.

There are two varieties of this oil. The most valuable is the “cold drawn,” which is extracted by cold pressure, and is paler, less odorous, and has less taste than that obtained by the aid of heat. By cold expression, the yield of oil is from 21 to 22 per cent. of the seeds; with the aid of heat, combined with a powerful and long-continued pressure, as much as 28 per cent. can be obtained. If a very fine oil be required, the process of cold expression must be pursued; and as the utmost degree of purity is the great desideratum in varnish-making, this quality is generally employed by makers of high-class varnish. A very good oil, however, may be obtained by a steam heat not exceeding 200°.

The *marc* remaining after the expression of the oil is generally known as oilcake, and is an article of great importance to the

agriculturists of those countries in which flax is grown, being extensively employed, especially in the winter season, as food for cattle.

The mode of expressing the oil is as follows: The seed is first passed between iron rollers, in order to crack the husks. They are then introduced into a hopper, through which, by means of a fluted roller, they are caused to descend between the crushing rollers, after passing which they fall into a receiver. They are then passed on to two vertical granite mill-stones, which bruise them to a pasty mass, and this is then heated to a greater or less extent by being placed in pans over an open fire, or in connection with steam or boiling water.

The object of the heat is to coagulate the albumen contained in the seeds and render the oil more limpid, and, therefore, more easily expressed. The mass is then transferred to a hydraulic press. The method of pounding the seed in hard wooden mortars, with pestles shod with iron, and set in motion by cams driven by a shaft turned by horse or water-power, was formerly used. The bruised seed was then transferred to woollen bags, which were wrapped in horsehair cloth and squeezed between upright wedges in press-boxes. This arrangement, known as the Dutch mill, is still obstinately adhered to in some districts of England and the Continent, it being supposed to be preferable to the hydraulic mills and presses, which have in modern times almost entirely superseded the old method.

The manufacture of linseed oil in 1860 was estimated at 65,000 tuns, of which 33,700 tuns were exported. As our imports of linseed are now half as much more than they were in 1860, the make of oil must be proportionately larger.

IMPORTS OF LINSEED AND FLAX SEED into the UNITED KINGDOM.

	Quarters.		Quarters.
1840	444,759	1870	1,490,695
1850	608,984	1880	1,675,271
1860	1,330,623	1888	2,542,027

THE GROUND-NUT.—The plant (*Arachis hypogæa*) which produces the fruit, entering into commerce under the popular name of the ground-nut, is a little annual, with oblong leaves, growing in fours, and rather large yellow flowers, rising a little way above ground. It is one of a class which bury their pods in the earth, where they ripen, instead of raising them into the free air. In order to effect this, the flower-stalk, after the flower has passed away, gradually curves downwards, and at length forces its end perpendicularly into the soil, along with the very young pod which is seated there. Having buried itself sufficiently deep, the pod then begins to swell, and when ripe becomes an oblong, rugged, pale brown fruit, containing about two seeds, as large as the kernel of a hazel-nut. This plant is now found in a state of cultivation all over the hottest part of the tropics. It was unknown until the discovery of America, and every region in the old world where it

is now grown owes it to Brazil; so that we have in this plant a further example of the rapidity with which vegetables will take possession of soils where the climate is suitable, for it is grown very generally in different parts of Africa, in India, the West India Islands, and the United States. For the purposes of commerce, it is principally raised on the West Coast of Africa, in different quarters, from Senegal to Sierra Leone and the Gambia. Marseilles is the chief port to which they are shipped.

The imports of ground-nuts at Marseilles have largely increased in the last twenty years. In 1866 the imports of "arachides," as they are there termed, were: shelled 1,920, in the husk 298,170 metrical quintals of 2 cwts. In 1886 the kinds were reversed, the shelled amounting to 749,565 metrical quintals, and 131,635 of unshelled.

The produce of ground-nuts in the Congo State in 1886-7 was 24 tons. From the West Coast of Africa the ground-nut is exported in the husk, from the South-West Coast chiefly decorticated. The total imports at Marseilles in 1886 were 1,762,400 cwts. The large imports at Marseilles from India have interfered with the African supply.

The exports of ground-nuts from Gambia were in—

				Tons.					Tons.
1879	..	..	..	22,890	1883	..	..	..	23,076
1880	..	..	..	13,824	1884	..	..	..	18,402
1881	..	..	..	16,958	1885	..	..	..	12,352
1882	..	..	..	25,524					

The ground-nut is principally cultivated down the borders of the river, and in British territory by the Serrawoolies. They are a nomadic tribe of Mohammedan farmers of the Senegambia; they leave their wives and children far up the country, and wander to the seaboard in search of fallow ground, to be left again as soon as the crops have worn out the soil. The native has unfortunately introduced, of late years, the pernicious system of beating, or threshing, instead of picking by hand, whereby the nuts are mixed with leaves, stalks, stones, and other extraneous substances, causing large deductions in the French market, and depreciating their value in the United States as an article of food, or, better to be described, as a favourite dessert for the tables of the rich in the latter country. The resident native, the Jolloffe, or the liberated African, surrounded by his Lares and Penates, in the shape of women, children, and domestic servants, or slaves, takes his time to pick the nuts, saving the haulm for the Bathurst market, where it meets with a ready sale as fodder for horses; but the Serrawoolie, who is anxious for quick returns, has not the time, and certainly not the energy, to pick two acres of ground-nuts between December and May, land which he can easily dress, work, and sow in June and November, hence he loses the fodder, but brings a larger quantity of nuts to the market.

Hand-shelled nuts may be advantageously used in Europe for eating and by confectioners, but those machine-shelled are only fit

for oil-crushing and cattle-feeding purposes. The oilcake of the nuts when pure is highly esteemed for its fattening properties; horses, cattle, pigs, and poultry are very fond of the ground-nut in its natural state. A heaped imperial bushel of the nuts weighs from 25 lbs. to 32 lbs. Divested of their shell (1 per cent. of the weight) the kernels furnish as much as 45 to 50 per cent. of oil.

Besides the great value of its seeds for oil, this is also a good fodder herb. The plant is a very productive one, and yields a quick return. A light, somewhat calcareous, soil is best fitted for its growth. In tropical countries half a ton weight of seeds or nuts is obtained.

The oil is used for alimentary purposes, and for cloth-dressing, but its chief use is for the manufacture of soap, and for lubricating machinery. As a lamp oil it burns longer than olive oil, although its illuminating power is less. Compared with ordinary burning oils its power is feeble. It has the advantage, however, of keeping a long time without becoming rancid.

Under favourable circumstances, the nuts will produce half their weight of oil, and the quantity is much increased by heat and pressure. In India the mean yield of oil is only 37 per cent. at Pondicherry, and 43 per cent. in Madras. In Europe it is usually found that a bushel of ground-nuts produces one gallon of oil when expressed cold: if heat be applied a larger quantity is obtained, but of inferior quality.

In Brazil this seed is known under the name of "amendoum," and has long been used there parched for food and to extract oil from. The oil is used for cooking, medicinally for rheumatic affections, and for lighting. It is sometimes called pindar nut.

The roasted seeds are sometimes used as a substitute for chocolate; according to Dr. Davey, they abound with starch, as well as oil, a large proportion of albuminous matter, and in no other instance had he found so great a quantity of starch mixed with oil.

Dr. Muter, after giving the following analysis of ground-nut meal, urges its more general use as an important article of food:—

	Per cent.
Moisture	9·6
Fatty matter	11·8
Nitrogenous compounds (flesh formers)	31·9
Sugar, starch, &c.	37·8
Fibre	4·3
Ash	4·6
Total	100·0

From this analysis it is evident (he observes) that the residue from them, after the expression of the oil, far exceeds that of peas, and is even richer than lentils in flesh-forming constituents, while it contains more fat and more phosphoric acid than either of them. On these grounds we are justified in urging the adoption of the ground-nut meal as a source of food, it being superior in richness of all important constituents to any other vegetable product of a

similar nature. Although in the raw state it possesses a somewhat harsh odour, similar to that of lentils, this flavour entirely passes off in cooking, and when properly prepared it has a very agreeable flavour.

This seed is held in such estimation for eating in the United States (where it is known as the "pea-nut") that flourishing sale-stands are seen at almost every street corner of New York. They are not much appreciated in England, except by children. In America $3\frac{1}{4}$ million bushels are sold annually.

There are fully 750,000 bushels sold yearly in the city of New York alone. Previous to 1860 the product in the United States did not amount to more than 150,000 bushels, and of this total nearly five-sixths were from North Carolina.

It was estimated that Virginia, Tennessee, Georgia, and Carolina, sent conjointly over 3,000,000 bushels to market in 1886, of which one-fourth went to New York. As much as 10s. to 12s. is paid for the bushel. The yield is from 80 to 120 bushels on an acre.

This plant has been naturalised in India for many years. The seeds, when in season, are sold in every bazaar, and are largely eaten by the natives. They are also exported to France and elsewhere for the manufacture of oil, of which they contain a large amount. In Netherlands India it is called katjang, and there is a large export from Java, principally to China.

In Cochin China there are 24,000 acres under culture with ground-nuts; in Senegal about 100,000 acres; and 40,000 acres are there devoted to sesame.

Senegal and its dependencies, which exported in 1840 but 1210 kilogrammes of ground-nuts, now produce 50,000,000 kilogrammes. Cayor and Casamance furnish the largest quantities; but some cargoes are also sent from Galam, which are more esteemed than from the other localities, on account of the thinness of the husk or shell and the superior yield of oil. It is one of the principal resources of the country, and the production is annually more and more extended, notwithstanding the impediments which the Moors throw in the way of its traffic, under the dread that their gums might be neglected. The principal market for Senegal proper is the large village of Gandiole. About Goree, the centre of supply is Rufisque; lower down Sedhiou and Carabane in Casamance, and Albreda, on the Gambia. At the Gaboon, where the population is thinly scattered, and little agricultural, all that is produced is locally consumed.

According to Dumas, it was a Marseilles house that first thought of introducing this substitute for olive oil. They commenced by experimenting with a few kilogrammes, and now the imports into France exceed 50,000 tons, of an oil-seed unknown to commerce forty years previously.

In Angola the nut is called mfunda and ginguba.

The ground-nut is now cultivated on a large scale in India, where the seeds form a considerable article of commerce, and there is also a quantity of the oil exported.

Ground-nut oil is used in parts of India for alimentary purposes; in some countries it is sold for olive oil; in North Arcot it serves

to adulterate gingely or sesame oil, and at Pondicherry it is mixed with coconut oil.

At Mozambique the ground-nut is also largely grown.

COTTON-SEED OIL has been produced in Egypt, France, England, and the United States: but until lately not on a very large scale, or for commercial purposes. Each pound of ginned cotton produced, yields 3 lbs. of seed. One-half being retained for planting, there remains over 1,000,000 tons which might be manufactured. 100 lbs. of cotton seed will yield 2 gallons of oil, 48 lbs. of oilcake, and 6 lbs. of soap stuff: the total estimated value of all which is upwards of £7,000,000. The oil possesses excellent lubricating qualities. Soaps of every variety are made from it, and in New Orleans it has been used, with commendation, as a substitute for olive oil.

Numerous factories for the local manufacture of oil from cotton seed are now at work in the South, and a ready sale is found for the oilcake in the Northern States and in Europe, the product being of much value in feeding stock. The oil is one of the most useful of the vegetable oils, and brings, in New York, from 18*d.* to 20*d.* per gallon. The total production of cotton seed in the Southern States is about 2,230,000 tons, of which nearly one-third is produced in the valley of the Mississippi. The market price for the seed is \$12 to \$13 per ton.

Cotton seed is becoming one of the principal articles of export from Egypt. It has gradually risen from 1090 cwts. in 1860 to 250,000 tons in 1888, of the value of £1,500,000. England takes nearly all of this.

Mr. McLagan, in the 'Edinburgh Quarterly Journal of Agriculture,' some years ago, gave some interesting details respecting the feeding properties of the oilcake from cotton seed. Cattle do not take to it at first, but eventually get to like it and thrive upon it.

About 27 imperial stones of cake are obtained from 4 cwts. of seed.

The following figures show the quantity of cotton seed imported into Great Britain of late years. This seed was not separately enumerated before 1861:—

				Tons.					Tons.
1861	..	..	..	20,034	1875	..	..	..	202,205
1862	..	..	..	33,162	1876	..	..	..	230,284
1863	..	..	..	62,159	1877	..	..	..	264,619
1864	..	..	..	84,642	1878	..	..	..	172,719
1865	..	..	..	114,851	1879	..	..	..	179,166
1866	..	..	..	93,957	1880	..	..	..	229,520
1867	..	..	..	93,643	1881	..	..	..	232,199
1868	..	..	..	94,759	1882	..	..	..	209,689
1869	..	..	..	105,646	1883	..	..	..	248,531
1870	..	..	..	120,304	1884	..	..	..	212,928
1871	..	..	..	172,163	1885	..	..	..	270,486
1872	..	..	..	167,904	1886	..	..	..	255,701
1873	..	..	..	207,038	1887	..	..	..	276,570
1874	..	..	..	190,591	1888	..	..	..	255,500

Oil-seed Cake.—The oilcakes imported are all classed together; there is, however, a large home trade in those resulting from the British crushing mills. The marcs or cakes include ground-nut cake, palm-nut cake, linseed cake, cotton-seed cake, and coconut cake, used for cattle food; and mustard, rape, castor-oil, and undecorticated cotton-seed cake used for manure.

The following shows the progress of our imports of foreign oil-seed cakes:—

		Tons.			Tons.
1840	.. ..	71,039	1870	.. ..	158,453
1850	.. ..	65,145	1880	.. ..	241,157
1860	.. ..	108,826	1888	.. ..	259,573

The oil cake exported from India was in

Year.	Quantity.	Value.
	cwts.	£
1885	146,264	37,663
1886	132,230	35,064
1887	171,107	40,640
1888	221,559	52,481

The production of oil cake at the port of Marseilles in 1886 was 185,500 tons, consisting of the following kinds, in metrical quintals of 2 cwts. :—

Sesame	510,000
Ground-nut	590,000
Linseed	45,000
Cotton seed	170,000
Colza and rape	65,000
Poppy seed	70,000
Castor oil	90,000
Copra	90,000
Palm kernels	165,000
Illipe	40,000
Physic nut	5,000
Niger seed	15,000
	<u>1,855,000</u>

The largest portion, 1,000,000, was used in France, and the rest sent to Germany and other countries.

THE CASTOR OIL PLANT (*Ricinus communis*).—Although a native of India, this shrub is now widely distributed and cultivated in various parts of the world. In its native country it is a perennial, 15 or 20 feet high, with a thick stem. In cold climates it becomes an annual. There are many instances of perennial plants becoming annuals by change of climate.

The rapid growth of the plant is illustrated by an instance reported in Tennessee. A castor bean was planted in May, 1871,

in a garden in Memphis, and in November it had grown to the height of 23 feet, with a spread of foliage 15 feet in diameter. The trunk, 10 inches above the ground, was 18 inches in circumference.

There are many varieties of this plant, but they are generally believed to be derived from a single species. The most notable are *Ricinus sanguineus*, the stem, leaf stalks, young leaves, and fruit of which are of a blood-red colour; *R. Borboniensis*, which in southern climates attains a great height; and *R. giganteus*.

The following varieties may be enumerated, although described by some as species:—

1. *Ricinus communis*, Lin., the most widely diffused, with glaucous-purple stems.
2. *R. inermis*, Jacq., a native of India.
3. *R. viridis*, Willd., also an Indian species.
4. *R. lividus*, Jacq., Cape of Good Hope.
5. *R. integrifolius*, Willd., Mauritius.
6. *R. speciosus*, Willd., Java.
7. *R. apelta*, Lour. (*Rottlera cantoniensis*), China.
8. *R. mappia*, Lin. (*Mappa moluccana*), Amboyna.
9. *R. tanarius*, Linn. (*Mappa tanaria*), Amboyna.
10. *R. armatus*, or *communis*, Andrw., Malta.
11. *R. dioicus*, Forster (*Mappa tanensis*), islands of Southern Seas.
12. *R. tunisensis*, Desfont, Algeria.

The castor oil plant has been known from the remotest ages. Caillard found the seeds of it in some Egyptian sarcophagi, supposed to have been at least four thousand years old. Some people imagine it to be the same plant that is called the gourd in Scripture. It was called *aporave* by the Greeks, and *ricinus* by the Romans; in Hebrew *kikajon*, and called by Pliny *cici* or *kiki*. It is singular that the oil expressed from the seeds of the *cici* should have been used by the ancients, including the Jews, as one of their pleasantest oils for burning and for several domestic uses, though its medicinal virtues were unknown. The modern Jews of London use this oil by the name of oil of *kiki* for their Sabbath lamps, it being one of the five kinds of oil their traditions allow them to burn on such occasions. The seeds are oval, somewhat compressed, about 4 or 5 lines long, 3 lines broad, and $1\frac{1}{2}$ line thick; externally they are pale grey, but marbled with yellowish-brown spots and stripes.

The oil is obtained from the seed by expression, by boiling with water, or by the agency of alcohol. Nearly all that is consumed in England is obtained by expression. When the outer skin is first removed by rollers, previous to crushing and heating them, a clear and fine oil is produced, the outer cuticle being applicable for manufacturing and other purposes. By this process the thicker portion, or stearine, which is now lost (by being mixed and left with the outer skin or cuticle), is obtained, and the oleaginous or thin portion of the oil is not coloured and deteriorated. The oil thus obtained can be purified by jets of gas, acids, and heat at about 150° to 160° .

In America, the seeds, cleansed from the dust and fragments of

the capsules, are submitted to a gentle heat, not greater than can be borne by the hand, which is intended to render the oil more fluid and therefore more easily expressed. The whitish oily liquid thus obtained is boiled with a large quantity of water, and the impurities skimmed off as they rise to the surface. The water dissolves the mucilage and starch, and the albumen is coagulated by the heat, forming a layer between the oil and water. The clear oil is now removed, and boiled with a very small quantity of water until aqueous vapour ceases to rise, and a small portion of the oil taken out in a phial remains perfectly transparent when cold. The effect of this operation is to clarify the oil, and to get rid of the volatile acid matter. Great care is necessary not to carry the heat too far, as the oil would thus acquire a brownish colour and acid taste.

In the West Indies the oil is obtained by decoction, but none of it appears in commerce in this country.

In Calcutta it is thus prepared: The fruit is shelled by women; the seeds are crushed between rollers, then placed in hempen cloths, and pressed in the ordinary screw or hydraulic press. The oil thus obtained is afterwards heated with water in a tin boiler until the water boils, by which means the mucilage and albumen are separated. The oil is then strained through flannel and put into canisters.

Two principal kinds of castor seeds are known, the large and the small; the latter yields the most oil. The best East Indian castor oil is sold in London as "cold drawn." In some parts of Europe castor oil has been extracted from the seeds by alcohol, but the process is more expensive, and yields an inferior article.

Castor oil is a viscid oil, generally of a pale yellow colour, a nauseous smell and taste. Its specific gravity, according to Saussure, is 0.969 at 53° Fahrenheit. The acid taste which it sometimes possesses may be removed by magnesia (Gerhardt). At about 6° Fahrenheit it forms a yellow, solid transparent mass. By exposure to the air it becomes rancid, thick, and at last dries up, forming a transparent varnish. It dissolves easily in its own volume of absolute alcohol; castor oil and alcohol exercise a mutual solvent power on each other. It is also soluble in ether.

There are chiefly three sorts of castor oil found in the London market; viz. the oil expressed in London from imported seeds, East Indian oil, and the American or United States castor oil. Castor oil is imported in tins, barrels, hogsheads, and dippers. It is purified by decantation and filtration, and bleached by exposure to sunlight.

It is not quite decided how many kinds of fats castor oil contains; according to Gerhardt several, but Saalmuller says only two. It is, however, principally composed of *ricinoleine*, with perhaps a little stearine and palmatine, and an acid resin. Its ultimate composition is shown by the following comparative analyses:—

	Per cent.	Per cent.	Per cent.
Carbon	74·00	74·18	74·35
Hydrogen	10·29	11·03	11·35
Oxygen	15·71	14·79	14·30
Total	100·00	100·00	100·00

Castor oil seed is grown over the whole of the North-West Provinces; it is not of a very good quality, the yield of oil being generally inferior to the coast seed of Coconada and that of Colgong. The Dessie supplies the largest quantity.

The castor oil plant is extensively cultivated all over India. The plant is grown at Lucknow as a mixed crop. It is sown in June by almost all the villagers, not extensively, but principally for their own use. Its cultivation can be extended all over Oude. The oil is extracted by bruising the seed and then boiling it in water; the oil is afterwards skimmed off. This is the only seed out of which the oil is extracted by boiling, as in this case it is found cheaper than the methods used for other seeds, which is by pressure. The cost of the seed is one rupee per maund, and the price of the oil from two to five seers per rupee, according to the abundance of the crop in the season. The proportion of the oil yielded is about half the weight of the seeds when boiled.

In Cuttack the plant is grown all over the province, a good deal in patches of newly-cleared land, in the jungles of the Tributary States and Sumbulpore. The oil is used for burning and culinary purposes, and also medicinally. Both the native methods of extracting oil are wasteful and tedious, and therefore expensive. European oil-presses, and a knowledge of some methods of clarifying the expressed oil, seem only to be required to render the oil-seed crops of this extensive division of great value.

In a report on the industrial employment of castor oil, by M. Dareste, published in the third volume of the Bulletin of the Acclimatization Society of Paris, p. 349, he states that from the documents he had collected he found that a hectare under castor oil yielded 1800 kilogrammes. The average yield from oil-palms in intertropical regions was only 900 kilogrammes per hectare, and that of olives in the south of Europe but 600 kilogrammes. From subsequent researches he considers that the yield of oil from the castor oil plant would be even more, as he calculated the yield at 0·52 per cent., while subsequent trials proved that 0·62 to 0·64 could be obtained, differences which result from the mode of extraction employed.

Castor oil is said to be adulterated sometimes with croton oil, to increase its activity; this is a dangerous sophistication. It is also mixed with some cheap fixed oils.

If cold drawn it is suited to medical purposes, but hot drawn it is poisonous, and the eating of two or three of the dry and pleasant-flavoured seeds is deadly, inducing Asiatic cholera. This should be generally known if seeds are distributed. The easy and rapid

growth, the copious seeding, and the early return of produce render this important plant of high value in the warm temperate zone, more particularly as it will thrive on almost any soil, and can thus be raised even on arid places, without being scorched by hot winds. To obtain the best medicinal oil hydraulic pressure should be employed, and the seeds not subjected to heat; the seed-coats should also be removed prior to the extracting process being proceeded with. A screw-press suffices, however, to obtain the oil for ordinary supplies. By decantation and some process of filtration it is purified. For obtaining oil to be used for lubrication of machinery or other technological purposes, the seeds may be pressed and prepared by various methods under application of heat and access of water. For lubrication it is one of the most extensively used of all oils.

RAPE SEED.—From the seeds of *Brassica campestris*, *Brassica napus* (*Napa oleifera*, Spenn.), *B. annua*, *B. biennis*, and other species, all natives of Europe, is expressed the colza, or rape oil. The plants are extensively cultivated in the manner usually adopted in the culture of turnips, and raised solely for their value as an oil-yielding plant. The seeds are perfected the second year of their growth. The oil is extensively used for machinery, and for burning in lamps. The refuse cake is a well-known cattle food.

The seed is sown broadcast, in the month of July, upon well-manured ground, and if possible during wet weather. This is the seed-bed for the future plant. It should be sown as turnip or cabbage seed is sown, when it is intended to transplant the young plants. In the months of September, October, and November, the plants are taken from the seed-bed, and transplanted for the future crop. The field is richly manured with farmyard dung, spread broadcast on the land, and ploughed in. The previous crop is usually wheat.

The plants are then set out in rows about 2 feet distant from each other, and each plant 18 inches apart. In good soil, as, for instance, land partly broken up from old pasture, or from wood, the crop will be much heavier, and ripen more equally, if planted at a greater distance. It is usually planted in every alternate furrow, but the manure plough is expressly constructed for breadth of furrow. The plant is exceedingly robust, and soon recovers itself after transplanting. It thus remains permanently planted out until the month of February, when the horse-hoe is set to work to pulverize the soil after the frosts. Good careful farmers then add some artificial manure to encourage the growth of the plant. The manure generally employed is guano or rape dust, and the rape cake, which proceeds from the manufacture of the oil. Rape cake, indeed, is one of the very best stimulants that the plant can receive. After this spring manuring, the double mould-board plough passes between the drills, so as to throw the earth well up to the stalks of the plants.

There is another method, which is, to sow as the Scotch farmers

do turnips, in drills (manure in drills), apply guano or bone dust, or rape dust in spring, and in damp weather.

Do not transplant at all, but thin out, and cultivate as for swede turnip seed. I believe the crop would be as heavy, and the expense diminished one half, especially when labour is dear or scarce. The after management of the colza seed is not difficult, but requires attention. The seed, when fresh harvested, is apt to sweat and heat. For this reason, careful farmers who wish to preserve the colour and strength of the sample, generally stow the seed away with a sufficient quantity of the seed-pod or husk. These substances mixed through the heap, prevent its taking heat. The bulk must, nevertheless, be repeatedly turned over, and the granary kept aired. The yield of oil, which is the ultimate and real test of the value of the crop, varies exceedingly. This difference is not so much to be attributed to the variety of grain as to the nature of the soil, the geniality of the season, and the care bestowed on the culture of the plant.

Nothing more is done till harvest, which occurs towards the middle of July. The chief enemy of the rape-seed crop is hail; the heavy rains of July are also often prejudicial. As soon as the straw and seed-pod become yellow, the crop is ready to cut. This is done by the sickle, and the reapers place the crop as it is cut across the ridges, so as to leave the air to circulate as much as possible. In from six to ten days the crop is ready for the flail. It is a seed that sheds itself with great ease, and must be handled tenderly or much seed will be lost. The crop is thrashed in the field. A large space is cleared, and a sail-cloth spread on the ground. A light species of hand-barrow or cradle is constructed, and lined with canvas. It is carried by two persons across the field, and they gather up the sheaves, which, as lightly as possible, they deposit in the cradle or hand-crib. When they arrive at the thrashing place, they simply overturn the cradle and leave the sheaves on the floor.

The least possible stroke of the flail suffices to dislodge the seed. After thrashing, the grain requires to be constantly turned in the store, or it will speedily heat, and consume the strength of the oil. The produce of *an excellent crop* is half a French bushel, or 25 French quarts (litres), to every perch of 24 square feet. In round numbers, the yield of the crop may be estimated at 25 bushels to the acre, and it often exceeds this. The profit is so very considerable, that for many years it was estimated that the Norman farmers paid rent and expenses from the rape-seed crop alone. The land rent may be averaged at 1 franc the perch, or 70 francs the acre, which includes all rates and taxes.

If the plant be cultivated too often upon the same soil, without adequate change of rotation, it will, as is frequently the case with clover, degenerate rapidly, and produce an inadequate return. A crop which stands well and thick on the land will not always turn out to be the best *oil-bearing crop*. The average is, that it requires 4 hectolitres, or 400 French quarts of seed, to give 200 lbs. of oil in the rough. The expressing the oil, facilities

for purchase of steam fuel, or water power, and the chemical processes connected with rectification, are all elements of the expenditure.

Colza culture extends through the regions of the north-west and the plains of the north, but is little known in the south and the mountains of the centre.

The production of colza has much declined in France, owing to the more extensive employment of mineral oils. The departments where this oil-seed was principally grown were Pas de Calais, Calvados, Seine Inférieure, Nord, Somme, Saone et Loire, and Eure.

IMPORTS OF RAPE SEED into the UNITED KINGDOM.

		Quarters.			Quarters.
1840	.. ..	81,745	1870	.. ..	551,107
1850	.. ..	107,029	1880	.. ..	398,804
1860	.. ..	269,403	1888	.. ..	279,615

MUSTARD SEED.—A number of species of this family are cultivated for their seeds in Europe, north Africa, and northern and middle Asia. By some the plants are referred to *Brassica*; others continue them under *Sinapis*. The seeds of white mustard (*Sinapis alba*, Linn.) are less pungent than those of the black mustard (*S. nigra*), but are used in a similar manner. Dr. Masters enumerates *S. chinensis*, *S. dichotoma*, *S. pekinensis*, *S. ramosa*, *S. glauca*, and *S. juncea* among the mustards which undergo cultivation in various parts of Asia, either for the fixed oil of their seeds or for their herbage. From 15 lbs. to 20 lbs. of seeds of the white mustard are required for an acre. In the climate of California 1400 lbs. of seed have been gathered from an acre. In China an oil is expressed from *Brassica sinensis* in increasing quantities all through the valleys of the Yang-tze and Han rivers.

Very primitive machinery is used for the purpose. The seeds are crushed, steamed, and put into wooden cylinders, usually made by hollowing out the trunks of trees. The oil is squeezed out of the mass, placed in coarse bags, by means of wedges forced down by mallets, or by an arrangement similar to that by means of which piles are generally driven into the earth. In the last case water power is sometimes employed. The oil is of a dark yellow colour, thick, and has a pleasant odour. It is used for lamps, in cooking, and as a hair oil.

The seeds of *S. nigra* and *S. alba*, simply crushed and then sifted, constitute the mustard of commerce. The mixture is commonly two parts of black and three of white mustard flour, but the proportions used by different manufacturers vary. For medicinal use the black seeds are preferable for sinapism and other purposes. In rich soils this plant is very prolific. The chemical constituents are a peculiar acrid fixed oil, crystalline sinapin, the fatty sinapisin, myron-acid, and myrosin.

There are two sorts of mustard: the white mustard, which is grown for oilcake for sheep feed, and for green manure to be ploughed in for wheat; and the brown mustard, which is chiefly

grown for use as a table condiment. On the marshy and wild coast soils of east England it is common to take three or four crops of brown mustard running, and in that way to pay for the fee simple of the land (from £60 to £100 an acre), when the opportunity is presented. The tillage required is next to nothing; a shallow furrow is ploughed, the seed is sown broadcast, a bushel of seed an acre in April, and is ready for harvesting in June or July. The land is generally sufficiently seeded to produce another crop; which may, perhaps, be gathered in the autumn of the same year. In England brown mustard often fetches from 15s. to £1 a bushel, and 40 bushels is no uncommon crop. White mustard is less remunerative and less speculative.

Mustard seed is cultivated in many departments of France, and especially in the Nord, Pas de Calais, Bas Rhin, and the Charente. The annual produce is about 650 tons, worth £6000. Triturated in special mills, mixed with vinegar, and flavoured with some condiments, it is delivered to the trade ready for the table. The quantity produced in France was stated in the official Catalogue of the Paris Exhibition of 1867 at 3000 tons, of the value of 2,000,000 francs.

Five or six species of *Sinapis* are cultivated throughout India for the sake of their oil, which is much esteemed in the country for cooking, for medicine, and for anointing the body, which it is supposed to invigorate. The true mustard is scarcely met with in India. Those chiefly grown are cole seed (*Brassica campestris*, Linn.), or *Sinapis dichotoma*, Roxb., *B. campestris* var. *glauca*; the sarson or Rape, *B. Toria*, *B. glauca*, Roxb. *Brassica juncea*, Hooker, *Sinapis juncea*, Lin., is largely grown in the south of Russia, and in the steppes north-east of the Caspian Sea. Eight hundred tons of the seed are used in one factory annually for making mustard, and the seeds yield more than 20 per cent. of a fixed pleasant oil.

The imports of colza and ravison seeds into Marseilles ranged from 300,000 to 660,000 cwts. up to 1878, but they have declined since to 175,000 cwts.

SAFFLOWER OIL.—This is a light yellow clear oil, when properly refined or prepared; it is used in India for culinary and other purposes. This oil deserves more attention than it has hitherto received in this country; and, if once fairly introduced, there is no doubt whatever of its becoming a staple import. It is used in some of the Government workshops as a “drying oil,” and is believed to constitute the bulk of the celebrated “Macassar oil.” The seed is exported under the name of Curdee, or safflower seed. The Lucknow Exhibition Committee furnishes the following note: In Oude it is sown in October, either alone, or at the edge of wheat crops; both light and heavy soils are adapted to it. It is cultivated in every village, but not extensively. There would be no difficulty in further cultivating it to any extent. The oil is extracted by pressing. The cost of the seed, which is called

“Barré,” is $18\frac{3}{4}$ seers per rupee, and the cost of the oil from 3 to 4 seers per rupee.

SESAME SEED (*Sesamum indicum*, Dec.), frequently called Til, or Gingely. This is an erect, pubescent annual herb, from 2 to 4 feet high, indigenous to India, but propagated by cultivation throughout the warmer regions of the globe. In Europe it is only grown in some districts of Turkey and Greece, and on a small scale in the islands of Malta and Gozo. It does not succeed well in the south of France. From southern Asia it extends eastward to Japan, and is cultivated as far as 42° N. lat. It has a wide range, being grown in parts of South and Central America, British Guiana, and the West Indies. In the former it is known as *ajonjoli*, in the West Indies as oily seed, and in Demerara as *wanglo*. When parched and pounded the seeds make a rich soup. Children are very fond of the seeds, which have a milky flavour. In Egypt they are eaten after being baked in an oven and sprinkled over bread and pastry. The residual cake, after the oil is extracted, is also eaten kneaded with honey.

Benni seed, as it is called in parts of Africa, is extensively used in Oriental countries for aromatizing the church bread and for the preparation of the renowned *Chalba*, which is eaten during fasts by all Orientals. It consists of the finely powdered seeds, which are mixed with honey, and oftentimes also with sugar.

The negroes use the seeds for making a sort of beverage, something like coffee, by roasting and infusing them in water.

Til seed is grown in the northern provinces of Siam. There are 870,000 acres under culture with this oil-seed in the Madras Presidency, chiefly in the Godavery. Three varieties of sesame seed are cultivated in India, the white-seeded (*Suffed-til*), the red or parti-coloured (*Kala-til*), and the black variety (*Tillee*); it is the latter which affords the greater proportion of the gingely oil of commerce. A second sort of sesame oil, sometimes called “rape,” is obtained from the red-seeded variety. Black sesame is sown in March and ripens in May. Red sesame is not sown till June. The word sesame is said to be derived from *simsim*, the Arabic name of the plant. One of the advantages of the culture of this plant consists in its quick return of produce, as it comes to perfection within three or four months. Its capsules contain numerous small, flat seeds. To collect them, the plant, when mature, is cut down, and stacked in heaps for a few days, after which it is exposed to the sun during the day, but collected again into heaps at night. By this process the capsules gradually ripen and burst, and the seeds fall out. The plant is found in several varieties, affording respectively white, yellowish, reddish-brown, and black seeds. The dark seeds may be deprived of a part of their colouring matter by washing, which is sometimes done with a view to obtain a pale oil. The white seeds produced in Sind are reported to yield the finest oil. The seeds are largely consumed as food both in India and tropical Africa. The island of Formosa grows a large quantity,

and it is also cultivated in Zanzibar and Senegal. This oil-seed now also appears in the markets of Bakel. The yield of oil from the seed is about 40 to 50 per cent., and its specific gravity 0.9253. The Jaffa sesame seed is all exported to France, as it is much appreciated there, and considered to be of the best kind on account of its making fine oil for eating purposes. It fetches the highest prices of any in the Marseilles market. The chief place for the manufacture of sesame oil is Marseilles, and the importance of the trade in it may be judged from the receipts at that port, in metrical quintals:—

Year.	From the Levant.	From India and Africa.	Total.
1855	159,703	190,512	350,215
1865	60,260	259,510	319,770
1875	125,950	297,670	423,620
1886	117,940	824,370	942,310

The oil first expressed from the seeds is available for table use, and may be used for all the purposes of olive oil. As its congealing point is some degrees below that of olive oil, it is even more fitted for cool climates. The soot of the oil is used for making Indian ink. This oil is probably consumed to a greater extent than any other by the natives of India, and is second only to coconut oil in importance as an article of commerce. The residue, or cake, is eaten by the poorer classes of India as an article of food, and it is greedily devoured by cattle.

In Eastern Africa the sesame grows everywhere on the coast, extends far into the interior, and is known as *simsim*. The seed is pounded dry in a large mortar; when the oil begins to appear, a little hot water is poured in, and the mass is forcibly squeezed by huge pestles; all that floats is then ladled out into pots and gourds, and used for cooking.

At Angola sesame has been cultivated for more than twenty years as an article of export; it grows near the coast in soils too arid for ground nuts. From Sierra Leone the exports are falling off, as the following figures will show:—

	Cwts.		Cwts.
1881, shipments,	28,000	1884, shipments,	8,561
1882 ,,	21,216	1885 ,,	6,458
1883 ,,	21,116		

A few cwts. are also exported from Lagos and the Gold Coast. The seed is there called *Beni* seed. About 1500 cwts. are produced in the Congo State.

NIGER SEED.—Another oil-seed which enters into English commerce from India for oil-crushing, is the small black seed of *Guizotia oleifera*. It is commonly cultivated in Mysore and the

Deccan. The oil is sweet-tasted, and is used for the same purpose as gingely oil, though an inferior oil. It is the common lamp oil of Upper India, and is very cheap. The seed is sown in July or August, after the first heavy rains, the fields being simply ploughed, neither weeding nor manure being required. In three months from the time of sowing the crop is cut, and after being placed in the sun for a few days the seeds are threshed out with a stick. The produce is about two bushels per acre. It is also called ram-til.

The progressive increase in the importation of oil-seeds at Marseilles has been remarkable, as is proved by the quinquennial returns, in metrical quintals:—

1855	753,680	1875	2,228,280
1860	1,093,970	1880	2,989,590
1865	1,376,770	1885	3,245,200
1870	1,849,860		

OIL-SEEDS RECEIVED at MARSEILLES in 1886.

	Metrical Quintals of two cwts.
Sesame, from Levant	117,940
„ India and Africa	824,370
Ground-nuts in shell	131,635
„ husked	749,565
Poppy seed	109,270
Copra	260,910
Linseed	62,080
Colza	73,245
Rape	11,695
Palm kernels	281,450
Castor oil seed	146,715
Cotton seed	213,110
Illipe and Bassia	58,255
Niger seed	21,590
Purging nuts	6,730
	3,068,560

The value of the oil-seeds exported from India to Marseilles is over £3,000,000. The quantities were in—

	Cwts.		Cwts.
1881-82	4,028,348	1884-85	5,923,500
1882-83	3,923,964	1885-86	5,150,681
1883-84	5,259,504		

The total quantity shipped from India in the last-named year was 17,280,147 cwts., of the value of £9,948,350. Nearly half of this amount came to England, and the remainder went mostly to France and Belgium.

The quantity and value of the various oil-seeds shipped from India in 1875 was only 6,629,939 cwts., value £3,207,808.

OILS EXPORTED FROM INDIA, GALLONS.

Kinds.	1885.	1886.	1887.
Essential	10,043	8,833	12,523
Castor	3,207,045	1,190,888	2,676,012
Coconut	1,553,887	1,170,177	1,099,864
Til or Jingili	87,896	77,625	198,169

The declared value of all these in 1887 was £748,861.

QUANTITY OF SEEDS EXPORTED, CWTs.

Kinds.	1885.	1886.	1887.
Essential	49,616	47,279	51,416
Castor	476,396	670,537	610,893
Linseed	8,746,596	9,510,139	8,656,933
Mohwa	..	..	78,544
Mustard	37,348	24,047	33,362
Poppy	659,900	695,097	612,654
Rape	4,521,933	3,721,840	2,664,693
Til or Jingili	2,646,484	1,759,343	2,121,119
Other sorts	435,955	196,195	104,195
Ground-nuts	676,460	655,670	945,895

The acreage under oil-seeds in India in 1886 was as follows:—

Madras	1,364,093
Bombay	2,013,527
North-West Provinces	677,450
Oudh	314,934
Punjab	752,013
Central Provinces	1,705,017
Lower Burma	28,251
Assam	163,353
Berar	939,082
	<u>7,957,720</u>

The enormous amount of seeds exported from India is out of all proportion to the quantity of prepared oils—hence mills for the preparation of oil in India would seem likely to prove highly remunerative.

OIL SEEDS SHIPPED from INDIA in 1884.

	Cwts.
Linseed	8,543,766
Rape seed	3,945,727
Til or Jingili	2,853,382
Ground-nuts	712,954
Poppy	514,228
Castor seeds (1881)	10,229,109
„ (1885)	18,250,688

OIL SEEDS SHIPPED in 1885.

	Cwts.
Linseed	8,746,596
Rape	4,521,933
Til or Jingili	2,646,484
Other sorts	2,286,059

The following table shows the fluctuation in the imports of various kinds of oil-seeds at Marseilles for ten years, in metrical quintals of 2 cwts. :—

Year.	Sesame.	Ground-Nuts.	Linseed.	Cotton Seed.	Copra and Palm Kernels.	Colza and Rape.	Other Sorts.
1877	696,740	406,570	165,670	203,350	224,060	159,710	84,840
1878	536,790	716,590	264,535	119,310	204,430	376,230	77,020
1879	601,778	850,380	169,155	130,640	356,310	264,875	194,765
1880	927,425	1,052,165	99,430	213,100	322,210	242,485	132,775
1881	989,995	873,315	75,725	193,635	423,995	148,170	160,360
1882	880,740	908,055	113,305	210,725	247,390	139,140	228,780
1883	1,152,870	773,075	186,025	275,820	413,450	92,755	192,315
1884	992,785	851,165	164,900	306,390	402,420	83,380	444,160
1885	941,865	1,070,695	102,370	179,290	638,420	83,900	251,260
1886	942,310	881,200	62,080	213,110	542,380	84,940	342,560

The total imports have risen in the ten years from 1,940,940 to 3,068,580 metrical quintals.

GOLD OF PLEASURE (*Camelina sativa*, Crantz), an annual herb, is cultivated in middle and southern Europe. It is readily grown after corn crops, yields richly even on poor soil, and is not attacked by aphids. Thirty-two bushels of seed have been obtained from an acre, and from these 540 lbs. of oil. The return is obtained within a few months.

The gold of pleasure produces a finer oil for burning than the rape or mustard, having a brighter flame, less smoke, and scarcely any smell. It succeeds better than any of the other cruciferous oil plants on light, shallow, dry soils, and arrives so early at maturity that in the south of Europe it produces two crops in a season. In several of the more northerly districts of the Continent, as the north of France, Germany, and Holland, although it will not produce two crops in the season, it is found very useful for sowing in June or the beginning of July, when other crops may have failed; and when sown in the early part of the season,

it can be removed in time to be succeeded by turnips, grass seeds, &c. Besides the use of its seeds for oil, the stems yield a coarse fibre for making sacks, sail-cloth, &c., and being small, hard, and durable, are used for thatching temporary erections, and also for making coarse packing paper.

The seed may be sown in shallow drills, 10 inches apart, by the old-fashioned plan of a quart-bottle with a quill through the cork, and will be ready for the sickle some three months after sowing; the return of an average crop may be estimated at 300 to 1. The *Camelina* is understood to be a non-exhauster of the soil, used as a rotation crop, enabling old land to recover itself in some measure; it prefers soil of a light sandy nature, and is very hardy, enduring both drought and wet. Its usefulness consists in its quality for fattening stock of any kind. Two tablespoonfuls of the seed boiled in a quart of water will produce about the same quantity of thick jelly; and this mixed with a sufficient quantity and bulk of food will, it is considered, fatten the largest ox in a short time; the chaff which is left, after threshing out the seed, is readily eaten by horses.

In some countries this plant is cultivated both for its stems, which yield a fibre applicable for spinning, and for its oleiferous seeds, especially in Flanders. Although the soils best adapted for its culture are those of a light nature, a crop will never fail on land of the most inferior description. It is usually sown in spring in March or April, and in the autumn about August. The quantity of seed required per acre is 14 lbs. It may be either drilled or broadcast; if drilled, the rows must be one foot apart. If sown early, two crops may frequently be obtained in one year, as it is fit for harvesting in three months after the plant makes its first appearance. The seed is ripe as soon as the pods change from a green to a golden colour. Care must then be taken to cut it before it becomes too ripe, or much seed will be lost.

When cut with a sickle, it is bound up in sheaves and stacked in the same manner as wheat. It is then put into a barn, and threshed out like other corn. The oil is useful for burning in lamps, for dressing woollen goods, the manufacture of soap, lubricating machinery, and for painters. It is said also to be beneficial in asthma.

SUNFLOWER-SEED (*Helianthus annuus*).—The highly ornamental and extensive genus of plants to which this belongs derives its scientific name from *helios*, sun, and *anthos*, a flower, on account of the brilliant colour of the flower, and from the erroneous idea, propagated by poets and others, that the flowers always turned towards the sun; hence, also, the French name *tournesol*. It appears to possess far more profitable qualities than have been hitherto supposed, and may be cultivated with advantage and applied to many useful purposes. The great variety of valuable properties belonging to the sunflower seed has been more neglected than any other, when it ought to be paid greater attention to. No plant produces such fine honey and wax, and when the flower is in blossom bees abound on it. A few years ago one or two

farmers cleared nearly £40 by their honey alone. The produce will be according to the nature of the soil and mode of cultivation.

The sunflower has been long largely grown in parts of Russia for its oil, and the German farmers have lately taken up the cultivation. The plant grows readily in most climates. From the stalks of the plant the Russians manufacture a valuable potash, and the residue, after extracting the oil, made into oilcake, is used for feeding cattle. The leaves go to manure the soil.

The quantity of seed is much increased by dwarfing the plants; the best manure is said to be old mortar broken up. The plants should be kept clear and free from weeds. They should have sufficient interval between them for exposure to the sun, as under such circumstances they become larger and more fully stored with seed. The oil extracted from the seed is said to be superior to both almond and olive oil for table use, and for use in woollen factories, making soap and candles, and for lighting purposes. The leaves have been manufactured into cigars, possessing, it is stated, pectoral qualities which might prove more efficacious than stramonium. The blossoms furnish a brilliant yellow dye which stands well.

The marc, or refuse of 50 bushels of seed, after the oil has been expressed, made into cakes, will produce 1500 lbs., and the stalks, when burnt for alkali, will give 10 per cent. of potash. The green leaves of the sunflower, when dried and burnt to powder, make excellent fodder for milch cows, mixed with bran. Sir Allen Crockden, of Seal Grove, by Sevenoaks, for many years cultivated the sunflower, for the purpose of feeding his stock. The oil makes most beautiful soap, particularly softening to the hands and face, and is most delightful to shave with. Sheep, pigs, pigeons, rabbits, poultry of all sorts, &c., will fatten rapidly upon the cake, and prefer the seed to any other; pheasants in particular, causing them to have a much more glossy plumage and to be plumper in the body. It increases the quantity of eggs from poultry fed with it. The seed, shelled, makes when ground very fine flour for bread, particularly tea-cakes. It will grow in any corner that may be vacant, and make all farms have a most agreeable garden-like appearance. It should be planted about 6 inches apart, and about 1 inch deep, and when 1 foot high may be earthed up; it will then require no further attention. The main head of the plant generally produces 800 to 1000 seeds, and there are usually four collaterals, producing 50 to 60 seeds each. But it is not the seed only that is so valuable; the stalk is useful also, for by treating it exactly like flax, it will produce a fibre as fine as silk, and in large quantities. Now that rags have become so scarce, arising from the very unprecedented demand for paper, the stalk might be used for paper making. On some grounds two crops may be growing at the same time; when the farmer has given his early potatoes a last hoeing, he can plant his seed 12 inches apart in the ridges. The Chinese have it by thousands of tons, and worship it. There can be no doubt that many of their silk goods have a large portion of sunflower fibre in them. According to Boussingault, some experiments made by M. Gauzac,

of Dagny, gave the produce per acre of seed at 15 cwts. 3 qrs. 14 lbs.; the oil per acre, 275 lbs., being 15 per cent., and the cake 80 per cent. Next to poppy-seed oil, sunflower oil burns the longest of any in equal quantities. The seeds vary in colour, being either white, grey, striped, or black. From them is expressed a palatable, clear, and flavourless oil, the demand for which in Russia is very great. It is exported from St. Petersburg at about 10s. 6d. the cwt., and is said to be extensively used, like cotton-seed oil, after purifying, for adulterating olive or salad oil. In Russia a considerable quantity is grown for oil pressing. The plant is largely cultivated in Kiels and Podolia, eastward on the black soil lands; the stalks are used for fuel. The manufacture of the oil, which was formerly confined to the Government of Voroneje, has recently been carried on in that of Saratov, and in the town of that name there are at least thirty oil presses. The seed is supplied by the peasants of the neighbourhood. The production in Russia has been officially stated at 400,000 cwts. More than 200,000 cwts. of sunflower oil is made, valued at 3,000,000 roubles, one-third of which is sent to Germany, where the culture is now also carried on. The following practical instructions may be given to produce the plant in perfection. There is required a light rich soil, as unshadowed by trees as possible. The earlier the seed can be got in the ground the better, say the end of September or the beginning of October, as the crop will be ready to harvest the latter part of February, which will be of the greatest importance to growers. The necessary quantity of seed required for an acre depends on the condition of the soil, and varies from 4 to 6 lbs.; but of course it is advisable to sow a little more than is actually wanted, to provide against accidents. The seed should be drilled into the ground; the distance from row to row 18 inches; the plants to be thinned out to 30 inches from plant to plant; and the number of plants at this distance would be about 11,000 per acre; at 18 inches from plant to plant, 25,000 per acre; and at 12 inches from plant to plant, 32,000. The produce varies considerably, according to the state of the soil, the climate, and the cultivation that is employed; but the average quantity of seed may be taken at 50 bushels per acre, and the yield of oil at a gallon per bushel.

The seed varies in relation of husk to kernel from 41 to 60 per cent. of the former to 40 to 59 of the latter, and the percentage of oil between $16\frac{1}{4}$ and 28 per cent. On the average, however, about 18 per cent. of oil may be obtained by expression.

CANDLE NUTS.—Under the name of candle nuts there are imported into this country an oil seed, the hard fruit, either in the shell or broken, of the *Aleurites triloba* and *A. Moluccana*. The French call them Bancoul nuts, and in the Pacific islands they are known as kukui. *Aleurites triloba* is a native of the Malay islands and Assam. It is also cultivated in Lower Bengal. The kernels are much relished there, having the taste of English walnuts.

Two or three species are known, spread over the Molucca Islands,

Ceylon, and the archipelagos of the Pacific Ocean. It is very common in the forests of Cochin China, New Caledonia, Tahiti, Reunion, &c. The fruit, produced in abundance, falls to the ground when it has arrived at maturity. This nut is composed of a hard and ligneous shell, containing an oily kernel, of which the following is the composition :—

	Per cent.
Water	5·000
Oil	62·175
Nitrogenous substances	22·653
Non-nitrogenous substances	6·827
Mineral matters	3·345
	100·000

In its normal state it contains :—

Nitrogen	3·625
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According to this analysis, the kernel is rich in oil and in nitrogenous substances. It is worthy, therefore, of attracting the more prominent attention of manufacturers and agriculturists.

The nuts analysed came from Tahiti. The French Minister of the Marine distributed them to several manufacturers of oil, in order to experiment on them in their factories. The following is the composition of the oilcake :—

	Per cent.
Water	10·25
Oil	5·50
Nitrogenous substances	47·81
Non-nitrogenous substances	24·04
Phosphoric acid	3·68
Potash	1·53
Magnesia, lime, silica, &c.	7·19
	100·00

In its normal state it contains :—

Nitrogen	7·65
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This analysis shows that the cake is rich in nitrogen and in phosphates. It would be still more so if it did not contain a certain quantity of the remains of the shells, which could not be completely separated from the kernels. Monsieur Ed. Nay obtained from the kernels 55 to 57 per cent. of oil, 40 to 41 per cent. of cake. From these results, it must be admitted that the cake which is manufactured from perfectly shelled seeds might contain up to 9 per cent. of nitrogen, and 4 per cent. of phosphoric acid. It would therefore be a good manure of great value, superior even to ground-nut cake. It is not good for cattle food; at least, it must be supposed so. The oil expressed from the kernels is purgative, and could not therefore serve for alimentation. For lighting purposes it is superior to colza oil, and can be burnt without undergoing purification. A simple filtration suffices to render it clear and limpid.* It also appears that this oil is very

* The Nukuhivians light their huts with the very oily candle nut (*Aleurites triloba*), threaded on a skewer, which does not give them much trouble.

siccative, for when applied in layers on the hull of a ship, it preserves it for a long time from every kind of change. Some interesting experiments were made for this purpose on some men-of-war in Cochin China and at Guiana. Unfortunately the hard shell of the candle nut presents great difficulties, for the nut only contains 33 per cent. of kernel, the remainder being the hard shell, which is probably useless. It therefore results that on account of the high price of freight from the places of production it cannot be imported whole. The shelling must be performed before its shipment. According to the experiments made by Monsieur Ed. Nay, this husking is a very laborious operation, on account of the excessive hardness of the shell; nevertheless, it may suffice to make known the interest which attaches to this question to excite the emulation of inventors. He who constructs a simple, cheap apparatus, which can be transported to the colonies, to perform the desired work, will probably make a good thing of it and render a signal service to commerce.

A larger quantity of oil is obtained from the nut, and with much less difficulty, if, after the reduction of the kernels into a coarse powder, by means of a pestle and mortar, roller, or hand-mill, they are submitted to a low heat. For this purpose a water bath is used, care being taken to constantly stir the powder with a wooden spatula, in order to diffuse the heat equally throughout the whole mass. When the substance is sufficiently heated, it is placed in canvas bags and submitted to pressure. The oil escapes with much more facility, the heat having coagulated the albumen; it is clear, and can be immediately filtered. The oil may also be prepared by previously roasting the nuts in ovens. When they are broken, the kernel then separates very easily from the shell, which is not the case with the raw nuts. In the latter case the fragments of kernel are separated with the point of a knife, which causes a great loss of time. The oil which is obtained after this roasting is of a much darker colour than that which is extracted by the preceding process. In all cases the kernel must be completely separated from its outer shell, for in crushing the whole together an enormous loss is experienced. The following are the returns which were obtained, and with a stronger pressure a larger quantity of oil would result: 224 lbs. of whole nuts give 4 lbs. of kernels; 224 lbs. of kernels produce 50 quarts of oil.

At the Sandwich Islands, where it is prepared in large quantities, this oil is 40 per cent. cheaper than linseed oil. In commerce in the Pacific it is designated under the name of *Kukui* oil. The oil of this nut has many useful applications. In the arts it may be employed in painting as a drying oil; after having been boiled, it dries completely at the end of six hours. In the manufacture of soap it would replace at Tahiti with great advantage the coconut oil which is used. It is excellent for lighting purposes, and burns without the unpleasant odour which coconut oil gives out; it has not, like the latter, the disadvantage of deteriorating the lamps; lastly it gives a very brilliant light. It may be reckoned among the drastic purgatives. Very good effects are obtained with a dose

of 15 to 20 grammes in an aromatic potion. It is said to be used in Java at table, which must depend on a special mode of preparation, probably the fresh kernel has alone been submitted to pressure. It will thus be seen this oil merits being prepared in Oceania and in New Caledonia. Indigenous to those islands, it grows everywhere; on the tops of the mountains, where it appears to be most common, on the sloping and inaccessible parts, in deep ravines, in fresh and fertile valleys. It is very abundant up to a height of 2700 feet; above that it becomes rare, and disappears completely at 4000 feet.

THE JAPAN WAX TREE.—In Japan a considerable quantity of solid vegetable wax, which melts at 128° and congeals at 132° , is obtained from the seeds or berries of several species of *Rhus*; that which is most generally cultivated is the *Rhus succedanea*. This is grown amongst vegetables more or less extensively almost everywhere in Japan, especially in the western provinces from the south northwards to the 35th degree.

The lacquer tree (*R. vernicifera*) also yields the wax, and differs but little in appearance from the other species, except that its geographical limit extends farther northwards, being at 38° . The *Rhus sylvestris*, a wild species, is also utilized for the purpose. The cultivated species was originally imported from the Loo Choo Islands; the growers now distinguish seven different varieties of this tree. The wax tree grows in great abundance on the mountainous declivities of the province of Kinas, and in Hiozo, Hizen, Simabara, Chutugo, and Chekusin; the fields are hedged in with it. The seeds, which ripen in October and November, are of the size of a small pea, and united in bunches; the fat or wax is lodged between the kernel and the outer skin. When gathered they are exposed to the sun for a few days, and then stored in straw. When they have attained their proper maturity they are freed from the stems by threshing with flails of bamboo. They are crushed and winnowed, steamed, placed in hemp-cloth bags, steamed again, and afterwards pressed in a wooden wedge press by hand. In order to facilitate the flow of solid oil or vegetable wax, a small percentage of oil from the *Pirella ocimoides*, Lin., is added. The raw products form on cooling a coarse, greenish, tallowy mass, which is remelted in an earthen vessel with water and ashes; the yield is about 15 per cent. of the berries used. The wax is reduced to small scraps by means of a kind of planing tool, then washed and bleached in the sun and air, when it assumes a pure white colour. It is much used in Japan for candles. The exports of this wax from Hiozo and Osaka were 7410 piculs in 1874, and 10,056 piculs in 1875. Prices ranged between $11\frac{1}{2}$ and $8\frac{1}{2}$ dollars per picul. The consumption has greatly fallen off in London within the last few years, owing to previous high cost of the article, which induced buyers to substitute paraffin and other cheaper materials, and even the above low prices have not left a profit to the shippers.

The wax is now generally prepared in large square blocks or

cakes of 133 lbs., in place of the old saucers or round cakes of from 4 to $4\frac{1}{2}$ inches in diameter and 1 inch. thick, by which a saving in freight is effected. The value of this wax, shipped from Hiozo in 1875, was 93,277 dollars; from Osaka, 955 piculs, valued at 8986 dollars. The total value of the Japan wax exports were, in 1874, 215,642 dollars; in 1875, 186,244. Of vegetable tallow there was exported from Kew Kiang in China, in 1875, 2747 piculs.

POPPY-SEED OIL.—The seeds yield by expression about 50 per cent. of a bland and very valuable oil, of a pale golden colour, fluid to within 10° of the freezing point of water. It dries easily, is inodorous, of agreeable odour, and partially soluble in alcohol. By simple exposure to the rays of the sun in shallow vessels, the oil is rendered perfectly colourless. It is expressed by means of a heavy circular stone, placed on its edge, made to revolve by a long lever, and the apparatus is worked by draught bullocks.

Mr. Bingham furnishes the following note: "The seed has no narcotic qualities, but has a sweet taste, and is used, parched, by the lower class of natives as food; it is also much used by the sweetmeat makers as an addition in their wares. This and the seed of the Til (*Sesamum orientale*) are the only oil-seeds, with the exception of the coconut, which are used for that purpose. It produces, under the native method, a clear limpid oil, which burns very quickly. About 30 per cent. of oil is generally extracted, and the cake is then sold as a food to the poorer classes. The oil sells at about 5 seers per rupee at Shahabad. The production of this seed is only limited by the production of the poppy.

"In Oude each ryot sows from two to four beegahs in the month of October. The oil is extracted by the common native press. The cost of the seed is 10 seers for the rupee, and the oil sells for 3 seers for the rupee; two-fifths of the weight of the seed employed is about the proportion of oil yielded by the native process. The poppy seed is eaten by the natives made into sweetmeats, provided the opium has been extracted from the seed vessel, otherwise it is bitter and narcotic, and under these circumstances the oil extracted is also bitter. Used for cooking and burning."

Of poppy seed from India, the United Kingdom receives the greatest share. The exports are from 650,000 to 700,000 cwts. This export trade is almost entirely confined to Bengal, only a very small quantity being shipped from Bombay.

In France the poppy occupies an extent of 47,078 hectares of land in the region of the north-west, being grown for its seed.

MELON SEEDS (*Cucumis melo*).—Under the local name of "petit beraf" large quantities of these seeds are collected in various parts of Africa, as in Senegal, Abeokuta, &c. They yield 30 per cent. of a very fluid oil, much like olive oil, which is used for food and for soap-making. In China no less than 4295 piculs of melon seed, valued at £3451, were shipped from Chefoo in 1875. The

oleaginous seeds of other cucurbitaceous plants are also used; one called the “gros beraf” is the produce of the *Cucurbita miroor*, and called by the natives iam-bosse.

PHYSIC NUT (*Curcas purgans*, Lindl.; *Jatropha Curcas*, Lin.).—This small tree or shrub is grown in Brazil, the East and West Indies, and West Africa; but the principal seat of production is the Cape Verde Islands. In the tropics, hedges and enclosures are made with this shrub, as cattle will not touch the leaves. The seeds are excessively drastic, hence their general name of purging nuts. They are in size and shape like those of the castor-oil plant, but have a dull, black, cracked surface.

The French physic nuts or seeds of the coral plant, *Curcas multifida*, are as powerfully purgative as castor-oil seeds.

This plant grows in abundance in Casamanca, Gaboon, and other parts of the African coast could supply this oil-seed.

The bush from which the seed is obtained is readily increased by cuttings, which rapidly take root. The seeds are three or four, contained in a thin skin, which is black; the seed is of the same colour, and grows in bunches; the stems of the bushes are not strong, but they answer excellently for fences, with split bamboo tied on each side to keep them straight and together. The seeds are collected and the oil expressed in the usual way.

The oil obtained from the seeds is chiefly used for lamps, and also in cutaneous diseases and chronic rheumatism. The Chinese boil the oil with oxide of iron to make the black varnish used for coating boxes, &c. The oil is viscous, of a deep yellow, with a density of 0.918.

This oil has been frequently imported into England as a substitute for linseed oil. The colour is somewhat paler; it answers equally well. The seeds are known under the name of Pignons d’Inde by the French, and Purgueira by the Portugese.

About 350,000 bushels are shipped to Portugal from the Cape Verde Islands, the chief locality of production; they are afterwards sent to Marseilles, where 13,500 cwts. were received in 1886.

An oil obtained from another species in India (*Jatropha glauca*, Vahl.) is also used locally in medicine and for lamps. In appearance and consistence it resembles castor-oil. The seeds of other species, *J. multifida* and *J. gossypifolius*, are also purgative.

The following oil seeds were imported at Rotterdam from Africa in tons—

	1886.	1885.	1884.
Palm nuts	3,095	4,249	4,947
Palm oil	1,868	3,036	2,580
Ground-nuts	1,032	3,853	5,289
Sesame seeds	324	256	300
Copra	44	130	19

CROTON OIL.—This powerfully cathartic oil, well known in this country for its medicinal properties, is procured from the seeds of

Croton tiglium, a small tree, native of Hindostan, Ceylon, and the Moluccas. The oil is obtained by grinding the seeds, placing the powder in bags, and pressing them between plates of iron. The oil is then allowed to stand fifteen days, and afterwards filtered. The residue after expression is saturated with twice its weight of alcohol, heated on the sand bath from 120° to 140° Fahr., and the mixture pressed again. The alcohol is distilled off, the oil allowed to settle, and filtered after a fortnight. One seer (2 lbs.) of seed furnishes 11 fluid ounces of oil; 6 oz. by the first process, 5 oz. by the second. Sometimes the seeds are roasted before they are compressed. The seeds of *C. Roxburghii*, *C. Pavana*, and *C. oblongifolius* have similar purgative properties. So powerful, purgative, and emetic, is this oil, that one or two drops are sufficient for a dose.

CHINESE OILS.—Among the vegetable oils in China are cabbage oil or rape; Tung oil, from the berries of *Dryandra cordata*; ground-nut oil (*Arachis*); til seed (*Sesame orientale*); tea-seed oil from *Thea viridis*; oil pea (*Dolichos viridis*); and the oil bean (*Soja hispida*). The latter product forms a considerable article of commerce in China. This pulse oil possesses a great analogy to the ordinary edible oils of commerce; its odour and flavour are agreeable, and it is useful for burning. Exposed to a low temperature it becomes pasty, and resinifies rapidly when exposed to the atmosphere. Being a drying oil, it might serve to replace linseed in some of its uses. The plant has the character of a shrub, its branches near the ground, and attains a height of from 3 to 4 feet. It yields about 18 per cent. of fatty matter, and the Chinese regularly obtain 17 per cent. of oil from it. There are several varieties of this bean, white, yellow, and green. The yellow are made into a fermented mass, or cheese, called tan-fir, by macerating them in water and pressing them into a cake, adding lime and salt to precipitate the caseine, which is obtained in the form of a jelly. It is chiefly cultivated in the north of China, particularly in the province of Shantung. Upwards of 3000 junks are employed in its transport to the southern ports. From Che-foo there were exported, in 1869, 242,224 piculs of bean-cake, and 5570 piculs of bean-oil, and about 10,000 piculs of the cake were imported into Foo-Choo-foo, valued at £42,000. The cake is not only used for human food and for stock, but also as manure.

OIL OF BEN.—From the seeds of two species of a leguminous plant, *Moringa aptera* and *M. pterygosperma*, is obtained an oil which is valued for its fluidity. It is mild, almost colourless, does not turn rancid, and is of a pleasant taste. The oleine, when separated from the stearine, is highly appreciated by watchmakers, and also by perfumers, as it retains the most fugaceous odours without diminishing their softness. Hence it serves to fix the odorous principles of certain flowers, such as the tuberose, the heliotrope, and the jasmine. It is, however, rarely to be met with pure in commerce, and is generally replaced by virgin olive oil. One

species of the tree grows in several of the West India Islands, whilst the other, *M. aptera*, is found principally in Egypt and India, whence small quantities of the seeds are occasionally imported.

ESSENTIAL OILS.—The cultivation of lemon and citronelle grass for the distillation of essential oils in Ceylon has of late years attracted a good deal of attention, and there are about 10,000 acres under culture. The value of the total exports of essential oils, citronelle, cinnamon, lemon grass, &c., was in 1884 £41,000. The quantity reached 6,500,000 ozs.; that of citronelle oil rose from 1,760,000 ozs. in 1881 to 3,335,780 ozs. in 1883; cinnamon oil from 118,762 ozs. in 1882 to 76,224 ozs. in 1883. The quantity of essential oils shipped from India as stated at page 416, averages 11,000 or 12,000 gallons.

SECTION VI.

THE PRINCIPAL FRUITS OF COMMERCE.

VINE CULTURE AND THE GRAPE.—The culture of the grape for the purpose of making a beverage from the juice is, literally, “as old as the hills”—it dates from the era of Mount Ararat. The vine is now grown in almost every portion of the inhabitable globe, but thrives best between 32° and 50° of latitude, the most favourable location for a vineyard being the southern declivity of a hill. Hitherto the best wines have come from southern Europe, Madeira, the Canaries, and the Cape. In Greece, Hungary, Italy, Portugal, France, Spain, and parts of Germany and Switzerland, as many persons are employed in the culture of the vine as in all the other agricultural pursuits.

In the United Kingdom the grape seldom ripens well in the open air, although very fine hothouse fruit is raised, but there is a large import of fresh grapes from the Continent.

Of dried raisins we take for consumption in the United Kingdom about 450,000 cwts. per annum, and of dried currants about 900,000 cwts.

The muscatel grapes are those which by a costly process are made into “Pasas” or Malaga raisins. There are different qualities, which vary in price.

The green grapes (*Uva porron*) are gathered almost entirely in the provinces of Granada and Almeria. These large and oblong grapes, with a thick skin, are sent, still green, during the months of August and September to the north of Europe, packed in barrels of 50 or 100 lbs. weight, and filled with sawdust to prevent bruising and becoming mouldy.

There are imported into London about 40,000 barrels (of 50 lbs.) of Spanish or Almeria grapes, which are sold at auction by the fruit-brokers. This is exclusive of the Lisbon grapes (of which there are no available figures), and the large imports direct to Covent Garden market from the Continent. The cargoes arrive at different times from about the last week in May to August. The following have been the quantities of raw fruit (not otherwise described) imported into the United Kingdom, which include pine-apples, melons, &c.: *

* Apples were included previous to 1882.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	bushels.	£		bushels.	£
1867	237,598	139,079	1878	3,938,271	1,704,091
1868	337,631	160,388	1879	4,219,951	1,746,936
1869	303,565	150,619	1880	5,133,432	2,239,473
1870	252,228	131,967	1881	4,045,641	1,718,907
1871	1,128,568	596,107	1882	2,644,056	1,415,252
1872	1,691,703	1,024,685	1883	2,660,475	1,380,952
1873	1,324,608	762,710	1884	2,381,960	1,345,537
1874	2,622,914	1,109,984	1885	2,822,401	1,421,747
1875	2,220,412	986,248	1886	2,601,558	1,290,411
1876	2,372,779	1,218,625	1887	2,479,004	1,167,095
1877	3,053,724	1,481,639	1888	3,039,100	1,387,271

The quantity of wine taken for consumption in the United Kingdom has been as follows:—

Year.	Gallons.	Per Head of Population.
1845	6,736,131	0·24
1850	6,437,222	0·23
1855	6,296,439	0·23
1860	7,358,192	0·23
1865	11,993,760	0·40
1870	15,079,854	0·49
1875	17,243,942	0·53
1880	15,750,823	0·45
1885	13,767,928	0·38
1888	13,500,109	0·35

The following figures show the exports of wine from some of the principal producing countries:—

France, 1886	.. .. .	2,601,565 hectolitres.
Spain, 1886	.. .. .	7,639,980 „
Portugal, 1886	.. .. .	1,963,121 „
Italy, 1886	.. .. .	2,331,000 „
Austro-Hungary, 1886	.. .. .	1,597,382 cwts.

The following shows the acreage under vines in different countries in Europe:—

Countries.	Year.	Acreage.	Produce.
			galls.
Hungary	1886	897,998	86,520,610
Austria proper	1885	533,888	88,018,700
Italy	1886	4,759,275	782,427,800
France	1886	4,717,649	668,497,148
Germany	1886	297,143	33,067,584

France.—The vineyards of France form a very important part of the agriculture of the country. The vine is cultivated in the

south, in Burgundy, and the borders of the Moselle and Garonne. The vine covered, in the close of the eighteenth century, an area of a little more than 1,500,000 hectares, now it extends over about 2,500,000, very unequally distributed in seventy-seven departments.

Every year above 5,000,000 kilogs. of grapes enter Paris bringing to the municipality a revenue of 300,000 francs, arising from the *octroi* duty at 5·75 francs per kilog.

The vine occupied in France, in 1871, an area of 6,043,000 acres or more than $4\frac{1}{2}$ per cent. of the total surface of the country. The production of wine was 59,025,680 hectolitres, roughly valued at £62,000,000. The average produce per hectare was 24·42 hectolitres, and the mean price 26·27 francs. The average return per hectare being 642·42 francs. The departments where the production of wine was largest were:—

	Hectolitres.
Herault	9,581,000
Charente Inférieure	5,255,000
Gironde	3,689,000
Var	3,323,000
Charente	2,833,000
Arde	2,583,000
.. .. .	2,341,000
.. .. .	1,799,000
.. .. .	1,566,000
.. .. .	1,256,000
.. .. .	1,247,000
V.	1,209,000
Lot et Garonne	1,104,000
Saone et Loire	1,025,000

These fourteen departments, of which the first eight are situated in the south, furnish of themselves 66 per cent. of the total produce.

Taking the value of the yield, the departments do not stand in the same order. For instance, the most productive are (reckoning in millions of francs) the following:

	Francs.
Herault	196,000,000
Gironde	166,000,000
Charente Inférieure	105,000,000
Charente	57,000,000
Var	56,000,000
Indre et Loire	47,000,000
Gers	46,000,000
Lot et Garonne	44,000,000
Côte-d'Or	43,000,000
Saone et Loire	41,000,000
Gard	32,000,000

The vine has barely maintained its production in the vineyard which produce the choice wines, but in other localities where it has been largely manured and more productive vines have been substituted for those which bear less fruit, they now obtain double the quantity of grapes yielded thirty years ago.

The vine is trained in a hundred different ways in France. It is generally propped or supported in Burgundy, Champagne

Lorraine, Orleans, Macon, Touraine, and Berry. Most ordinarily it is cultivated on trellises, more or less elevated, in Bordelais, the Dauphiné, and the county of Nice. It has no support in Lower Languedoc, Provence, Saintonge, and Annis, and the culture is called the low vine system.

Those which grow on the slopes of mountains, or in localities where the temperature is not very favourable to the ripening of the fruit, are supported by maples, walnuts, and willows.

The vines which furnish the choice wines do not yield more than from 15 or 20 hectolitres of wine per acre. The average all round is only about 16 hectolitres.

The price of wine has largely increased, as will be seen by the following average per hectolitre.

		Francs.			Francs.
1851	.. .. .	10·00	1881	.. .. .	40·26
1861	.. .. .	29·00	1886	.. .. .	40·29
1871	.. .. .	29·00			

The total production of wine in France, according to the statistics of the Minister of Finance, has been as follows:—

	Hectolitres (22 galls.).		Hectolitres (22 galls.).
1860	 39,558,000	1875	 78,202,000
1865	 68,943,000	1880	 33,916,000
1870	 53,537,000	1885	 31,481,000

If we take other decennial periods for comparison we find that the production in hectolitres was in:—

	Hectolitres.		Hectolitres.
1852	 38,060,000	1872	 54,920,181
1862	 48,630,130	1882	 38,825,000

Algeria.—In 1875 there were 12,182 hectares under culture with the vine in Algeria by Europeans. Now there are 90,000 hectares, and the produce in 1888 was 3,000,000 hectolitres. The natives are also increasing their culture, and have many thousand hectares under culture with vines. The exports of wine in 1887 were 793,305 hectolitres.

United States.—The geographical distribution of the indigenous or wild vines of North America extends over four different botanical regions.

1. The northern region, embracing all the States north of the 38th parallel.

2. Those of the Southern States, Carolina, Georgia, Florida, Alabama, &c.

3. Those of the south-west, including Louisiana, Texas, Arkansas, and the eastern part of New Mexico.

4. California, Sonoma, and western New Mexico.

Besides these, European varieties have been introduced and acclimatized in the valleys of New Mexico and California.

The wild or indigenous American vines are the Scuppernong, *Vitis æstivalis*, *V. punctata*, and *V. cordifolia*.

Those cultivated are the Catawba in the districts of Columbia

and Boston, the Clinton, Henshaw, Isabella, Hartford prolific, Bartlett, amber, Labrusca, and Scuppernong.

The Henshaw and Scuppernong contain only about 8 per cent. of sugar in the pound weight, while the others range from 10 to 11½ per cent. The Clinton and Catawba contain the most sugar and alcohol.

The production of wine in the United States has been steadily increasing. The cultivation of grapes for vintage in America has increased to enormous proportions. In California, Missouri, Ohio, Pennsylvania, and Michigan the industry is considered very remunerative.

Within a radius of 25 miles of Cincinnati it is computed that there are 2500 acres of ground devoted to the culture of grapes. In favourable seasons the average of wine per acre is 200 gallons, equal to 500,000 gallons as the whole crop for the section described; worth, fresh from the press, \$500,000.

The Catawba grape, an indigenous variety, is now extensively cultivated in the west and south-west, and the Catawba wine bids fair to become an important article of commerce. The grape culture has spread, along both banks of the Ohio, to Pittsburg and Cairo, and in a southerly direction through Kentucky and Tennessee to Alabama, and westerly into Missouri.

On the Ohio an acre yields on an average 500 gallons of wine, an immense yield, compared with the average of France. The wine growers of Ohio are mainly Germans and their descendants.

California.—The growth of vines in California is increasing very rapidly, and proper attention is being paid to the selection of sorts suitable to the soil. There are upwards of 31,000,000 vines. The County of Los Angeles has 4,500,000 vines, producing annually 1,500,000 gallons of wine. The produce of an acre is 12,000 lbs. of grapes, worth 5*d.* per lb. The kinds grown are the Mission grape, the White Muscat, the Tokay Blassien, the Rose, the Peruvian, and the Black Morocco. Up to within a few years the production of wine was confined to the "Mission grape," a variety introduced by the Spanish missionaries nearly a century ago. This grape makes a coarse, rough wine, varying in some degree according to the soil, but always inferior to that made from the vines imported from Germany, France, and southern Europe. Wines assimilating to the Hock, Muscatel, and Burgundy of Europe are now manufactured in Sonoma, Solano, and Napa counties in considerable quantities, and where the requisite attention has been paid to their manufacture, and they have been kept two or three years before being offered in the market, the quality is excellent, and cannot fail to create a demand for them in the eastern States and England. The southern grape is more particularly suited to the manufacture of wines resembling Port and Angelica, and the latter is decidedly a superior article. Port is made here from very ripe grapes, those that hang on the vines until after the first frosts. The foot hills are particularly adapted to the cultivation of the vine, and in a few years the value of the wine exports may approximate to that of their grain.

The vineyard proprietors have begun to introduce French and Germans, in order to improve the quality of their wines.

There are more than 100,000 acres under vine. The State has vinicultural land enough to make as much wine as France, Germany, Hungary, and Spain combined could produce; and there is no shadow of doubt among those who have given the subject the closest study, that California will in some future time out-rank every other wine-growing region in the world. The foot hills of this State, which are held at one-tenth the price of land in France, have a vast productive capacity, and seldom fail to produce a good crop.

In the early days of California wine-making it was supposed that in order to make a good wine, grapes had to be over-ripe; hence the wines contained too much alcohol, and were too heavy for constant use. Of late there has been much improvement in this respect, which has been brought about by the introduction of European vines, having less saccharine and more acidity than the Californian grape. Producers have also learned that it is better to pluck the grapes before they are fully ripe than to await over-ripening.

In the vicinity of Coloma and the portion of El Dorado county sheltered by the grand old mountains, nestling by the river, overgrown with verdure, are more than two score vineyards, with hundreds of acres of bearing vines. No disease has ever been known among vines in this region, except perhaps a little mildew, but the frost and other meteorological influences sometimes injure crops.

The culture of the raisin-grape in California has attained considerable dimensions. Ten years ago the Californian raisin was unknown, but in 1887 the production was close upon 10,000 tons, and this immense production will have to be six times as large before the demand for the eastern States of the Union alone can be met. The price averaged by the Californian producer for this kind of fruit in the dryer is $2\frac{1}{2}d.$ per lb., which gives to the raisin-growers of the State a total of £200,000. The average raisin vineyards of Fresno, San Bernardino, and Los Angeles are not more than 20 acres in extent. From these 20-acre blocks, with the vines from four years old and upwards, the net amount per acre is from £15 to £50.

Mexico.—Vine culture and wine manufacture, although prosecuted on but a small scale, have been very successful, especially in the northern sections of Mexico. In many of the mountains of the Sierra Madre, vines grow abundantly, and show to what degree of prosperity this industry may reach when the producer can find his way to foreign markets.

Brazil.—The vine has been cultivated successfully of late in the provinces of São Paulo, Rio Grande do Sul, and also in certain portions of Rio de Janeiro, and Minas Gerães. In many places 1000 vines would yield 10 pipes, or 4000 litres. The American vine commands a preference. The wines made are all consumed locally.

In many of the British colonies the culture of the vine has occupied a fair share of attention, particularly in Australia and

the Cape of Good Hope, but there are many others in which it might be profitably extended. A pure unadulterated wine can be supplied from the Australian colonies, not only equal, but superior to the wines now in general consumption, imported into this country from the continent of Europe.

Our colonies may before many years become important purveyors to us of the pure juice of the grape. Hitherto they have contributed little or nothing to our supplies, but many of them have all the requisites of experience, soil, and climate, and, under encouraging circumstances, will send us hereafter considerable quantities.

The Cape Colony.—When we look back and see that in former years up to 1859 the Cape colonists could ship 1,000,000 gallons of wine, it seems strange to find how this colonial industry has retrograded. In 1855 there were about 12,000 acres under culture with the vine in the western district of the Cape Colony, and the produce was 34,221 pipes of wine and 4496 pipes of brandy. Vines covered 20,000 acres in 1880, and the number of vines in the colony now exceeds 70,000,000.

The productive power of the vineyards here greatly exceeds that of any other vinicultural country in the world, the yield being $86\frac{1}{2}$ hectolitres per hectare on the coast districts, and 173 hectolitres per hectare in the inland districts. In no country in the world can there be raised even half as much wine from the same area as at the Cape.

The following show the exports of ordinary Cape wines and their value:—

Year.	Gallons.	Value £.	Year.	Gallons.	Value £.
1881	48,770	—	1884	89,981	15,922
1882	44,088	10,299	1885	83,754	14,558
1883	115,499	21,474	1886	125,258	21,593

Of Constantia the exports are about 6000 to 8000 gallons.

The Cape wines, with a few exceptions, have in common a disagreeable and alcoholic taste; they are usually mixed with so much brandy that they cease to be wines, and become liqueurs. About 4000 gallons of brandy are made yearly.

Australia.—If there is one fruit more than another which luxuriates in the sunny clime of Australia it is the grape. According to the statistics of 1886 there were about 23,000 acres under culture there with the vine, distributed as follows:—

	Acres.
Victoria	10,310
New South Wales	5,840
Queensland	1,517
South Australia	4,590
Western Australia	649
Total	22,906

The wine produced by these was, in Victoria, 1,000,000 gallons; New South Wales, 666,000 gallons; South Australia, 500,000 gallons; Queensland, 150,000; and Western Australia, 100,000. This is exclusive of the brandy distilled and the table grapes sold.

Almost all the wine is consumed in the colony where it is made. The local consumption of European wines shows little diminution.

Australia may now be regarded as one of the wine-producing countries of the world.

Australia possesses fourteen indigenous species of *Vitis*, but most of them appear on the north coast of Queensland, but there are six kinds in New South Wales, amongst them *Vitis antarctica*. The wild vine of California, *V. Californica*, has been introduced into New Zealand and Australia; it is said to be phylloxera proof, from being so robust, and is being tried for grafting stock. It also makes a palatable wine, destined in the future to make the claret of California famous. It produces tannin and tartaric potash, has no striking aroma, is sufficiently neutral, and has no disagreeable taste whatever.

There is little wine made in New Zealand at present; only the North Island is adapted for the growth of the grape, and its culture has not become a settled industry. In Western Australia there are about 650 acres under vineyards.

Although at present wine can scarcely become an article of much export from Australia, it is interesting to watch the progress of the cultivation and to observe the rapid development of the vine. It was remarked in the Jury Reports of the London Exhibition in 1862 that with care and time there is every prospect of these colonies becoming the great wine-growing countries of that part of the world. Since that opinion was enunciated, remarkable progress has been made, and the quality of Australian wines received high favour at the Dublin Exhibition of 1865; those of Paris, 1867 and 1878; Vienna, 1873; and London, 1873 and 1886. There is, as might be expected in dealing with an area almost continental, and considering the numerous varieties of the vine that have been introduced from all parts of Europe, an infinite difference in the produce. We there find wines of the character of the German wines, others resembling the French wines, whilst some have the substance and body of the wines of Spain. It was at one time considered that Australian wines would not keep well, but the question has now been settled in the affirmative, for their natural strength is such that they require no fortifying. The raisins dried in some of the Australian colonies are unsurpassed for size and flavour, and the same may be said of currants.

As many vineyards will yield three tons of grapes to the acre, it can be readily seen that vine growing is a really profitable investment. On comparison of the various figures it will be found that the colony of Victoria far outstrips the older colony of New South Wales, which was the first to commence the culture of the

vine. *South Australia* stands third in position as the fosterer of the vine and wine-making, as the undermentioned figures show :—

	Acres under Vine.					Acres under Vine.			
1850	..	..	..	282	1865	..	..	..	6,364
1860	..	..	..	3,180	1886	..	..	..	4,590

but within the last two years many new vineyards have been planted, and she will soon reassume her position as the second largest producer of wine.

In *South Australia* Nature herself is opposed to the production of high bouquet wines; there she demands consideration for body, sweetness, spirit, and other high qualities of generous wines. The Riesling and Verdelho, when not tortured, yield wines second only to the Bucellas of Lisbon, and the sweeter kinds of Madeira, while the Donzellinha, the Black Portugal, the Shiraz, Mataro, and Grenache yield wines of the character of good port, such as it is known in Portugal, the strongest of Hermitage, and that peculiar produce known as Roussillon. The produce of the Australian vineyards may vie with those of the most favoured countries of southern Europe. The local consumption of colonial wines increases year by year. The price is yet too high to enable Australian wines to come into general consumption in England; but, if the rapid progress of production continues, there will soon be a large surplus to export to other countries.

If as much well-directed care and attention were bestowed on studying the true nature and capabilities of the must, as seems to have been expended on striving to force it to yield wines of a French or German character, the produce of *South Australia* would ere now have acquired even a better name than it enjoys.

In *South Australia* the production of Zante currants, and Sultana and other raisins, is satisfactorily progressing, and many of the growers are grafting their inferior vines with these valuable varieties. The first sample of *South Australian* grown Zante currants sent to Melbourne were pronounced of better quality than those imported from Europe; and, when we bear in mind the fact that more than £120,000 of dried fruit is annually imported into the Australian colonies, a large opening presents itself for the development of this industry.

New South Wales.—The introduction of the vine into Australia is due to the efforts of the late Sir W. Macarthur, who in 1840 received cuttings from Europe and planted them on his estate at Camden Park, about forty miles from Sydney.

In 1872 the number of acres of vineyards amounted to 2466, and of these 1084 acres of vines were as yet unproductive. There were made 413,321 gallons of wine, 1765 gallons of brandy, and 508 tons of grapes were sold for table fruit, from vineyards exceeding one acre in extent.

In 1888 669,988 gallons of wine and brandy were made, valued at £134,000.

New South Wales contains millions of acres of soil admirably

adapted for the growth of the grape, of which nearly every European variety is rooted in the colony, and the produce of her vineyards compares well with those of the countries of southern Europe. The wines of the Albury district, on the Murray, are famous throughout Australia, and the produce of the Hunter River and New England country has been awarded many medals at the great International Exhibitions of London and Paris. All through the coast districts the grape flourishes, and generously rewards the grower. It is to be found in nearly every garden, and, as an article of diet, it is within the reach of the poorest in the land. The consumption of colonial wine increases year by year, and it is thought that the wines of New South Wales, as well as those of the other neighbouring colonies, will compete successfully with the light wines of France in the English market. Wine-growing is a very profitable branch of agriculture in the colony, and may reasonably be expected, with the growth of population to be more so. It does not confine its rewards to the large capitalist, but will amply remunerate the man of small means who has the requisite skill and industry to enter upon it. One man can attend to eight or ten acres of vineyard by obtaining occasional assistance, and, if he have any mechanical ability, he can, as many of the small growers, who are chiefly Germans, now do, make most of his plant himself. Should he have to buy the plant, he will need a capital of from £50 to £100. A handy man who could do his own coopering would require less. A small grower could not reckon on more than 200 to 300 gallons of wine per acre. The largest manufacturer in the Hunter River district has, in favourable seasons, and from certain kinds of grapes, obtained 500 gallons per acre; but his average yield would not be more than from 200 to 300 gallons. Much depends upon the soil and the variety of grape. Five hundred gallons must be considered an exceptional yield. At 250 gallons to the acre, and 1s. per gallon for his wine-juice, the vigneron would get £12 10s. per acre, and 100 acres of vineyard would yield £1250 a year, leaving ample margin for casualties. The labour in a vineyard may be reduced to a small percentage on the produce by planting in such a manner that it can be ploughed in various directions, and by using suitable implements.

At Wagga Wagga, 309 miles from Sydney, there are some large vineyards, from which about 7000 gallons of wine are annually produced. At Albury, 386 miles from Sydney, there are 450 acres of vineyard, producing 100,540 gallons of wine, 100 gallons of brandy, and many tons of grapes for table use. In 1883 the vineyards of the district of Penrith produced 16,000 gallons of wine and over 34 tons of grapes for table use. At Windsor, about the same distance from Sydney (34 miles), the annual produce of the orangeries exceeds 600,000 dozen. At Mudgee 6200 gallons of wine are made, and 77 cwts. of table grapes and other fruit produced.

Victoria.—Following in the wake of New South Wales, and from cuttings obtained from Sir W. Macarthur's vineyards at Camden, the vine was introduced into Geelong, and, as early as the year 1851, the Hon. D. Hope had fair vineyards there in full

bearing, and producing a drinkable wine. The year 1855 showed 274 acres under culture in Victoria, producing 11,000 gallons of wine. Now there are over 11,000 acres under vines and upwards of 1,000,000 gallons of wine are made.

Great efforts have been made to improve the quality of the Victorian wines by better methods of manufacture and judicious blending; skilled vigneronns have also been introduced from Spain, France, and Germany. Victorian wines are now not only extensively used in Australia, but are being largely sought after in the United Kingdom, the continent of Europe, and British India. A large display of Australian wines was made at the Paris International Exhibition of 1889, and both Victoria and South Australia had tasting-bars, where wines were offered to the public. Viticulture has been most profitable to those who have undertaken it in Australia, and it is believed a great future awaits this industry.

In 1888, there was produced in the colony 1,167,874 gallons of wine valued at 4s. a gallon, and 3352 gallons of brandy at 10s. a gallon. The latter is chiefly used for fortifying the wine; 42,389 cwts. of grapes were sold as table-fruit at £1 a cwt. The wine made in Victoria, added to that exported, amounts on the average to rather over a gallon per head annually.

Queensland.—There is a fair quantity of wine made in this colony, some of which is very good after having the advantage of a year or two in bottle. It is almost all consumed in the neighbourhood where it is produced, and vine-growers mostly look for profit to the sale of the fruit. From the great range of soil and climate, it may confidently be anticipated that some of the districts will yet acquire a reputation beyond the colony for their vintages.

Tasmania.—Many years ago vineyards were established in Tasmania under vigneronns brought out especially from Europe, and wine—good wine, too—was made. But the industry did not then take root, and it was only revived, not upon the mainland, but on Maria Island, off the east coast, about 1885. The vines have succeeded there, and wine in small quantity, of considerable merit, was made there for the first time in 1888.

Cyprus.—This island has been celebrated from the most ancient times for the superior quality of its grapes. The wines produced may be classified under two distinct qualities—"sweet" and "common." In the preparation of the sweet wines, the grapes, after being gathered, are exposed during several days to the action of the sun before being pressed, which develops the saccharine matter contained in them. In the preparation of the common wine, the grapes are pressed immediately after being gathered from the vine.

The Cyprus grapes are of exceptionally good quality, and very moderate in price. Their culture is yearly increasing, and more care is being devoted to the preparations of the wines produced. The export of wine in 1884 was about 1,500,000 gallons, of which fully two-thirds went to Egypt and Turkey. The Cyprus common wines are reported to be rich in colour and full in body, qualities

which, combined with cheapness, render them especially useful for mixing. The wines known as *Commanderia* have always enjoyed a high reputation on the Continent when old.

The common wines are for the most part exported to Syria, Egypt, Turkey, and Trieste, but both the common and the richer wines are exported to Austria, Italy, and France, to be used in giving strength and flavour to the fruit of poor vineyards. Cyprus wine is somewhat heavy for ordinary use, and its value in commerce has been lessened by the flavour it derives from the practice of carrying it to port in tarred skins. Until recent years the wines were all prepared in jars, which, to make them resist during the process of fermentation, were also besmeared with tar. Wooden casks are now being extensively used instead of besmeared jars, and the wines are thereby made more marketable.

DRIED FRUIT—RAISINS AND CURRANTS.—The small kind of grape which produces the dried currants of commerce is grown almost exclusively on an extensive scale in Greece and the Ionian Islands, with a small quantity in Turkey. Cephalaria and Zante are the islands where the cultivation is principally carried on.

Propagation is effected by long cuttings buried nearly a yard where the soil is sufficiently deep, or in shallow soil they are laid in horizontally for about 2 feet and then turned up. The cuttings are supposed to root at every joint, and the depth to which they are inserted is for the purpose of reaching the moist subsoil in times of drought. Propagation is also carried on by grafting on other varieties of the vine.

The vines are planted in rows about 6 feet apart, a single shoot being trained vertically to a temporary stake about 3 feet high; this ultimately forms the permanent stock, and in a few years becomes sufficiently strong to be self-supporting. From its summit the young wood, consisting of six or seven shoots, radiates, and each of these is headed in between December and February to four or five eyes, so that the stock has about thirty fruit-bearing points, producing collectively from fifty to ninety bunches.

The new growth radiates umbrella-fashion from the summit of the stock to the ground, and the only training required by this method of culture is the insertion of an occasional prop or support under the heavier fruit-bearing shoots.

It is in the plains which environ the Gulf of Smyrna that the grapes are cultivated, which, in the shape of raisins, form so important a branch of the commerce of the country. Besides the currant there are three kinds cultivated—the red with large seeds, the large black grapes with small seeds, and the *sultanas* or seedless grapes. Neither the *Patras* currant nor the *Sultana* raisin appear to be intrinsically very distinct from numberless other varieties of small grapes; their special seedless character, which is correlative with the diminished size of the berry, may have originally been due to local circumstances of soil and climate, producing partially abortive blossoms and the absence of seed.

The geographical range of the successful culture of the currant vine is very limited. Patras is the metropolis, and smaller quantities are grown in the Southern Ionian Isles.

In Sicily raisins and currants are chiefly the produce of the islands of Patelsaria and Lipari. The black grapes or raisins of Smyrna are exported chiefly to France for wine-making and distillation; the red and Sultanas are for the table, and fetch a much higher price than the black.

Smyrna raisins are of four qualities. The best are grown on the peninsula of Carábournou, at the entrance to the Gulf of Smyrna; the second quality at Vourlah within the gulf, and at Phokes, just outside it; the third at Chesmé, on the coast opposite to Scio; the fourth, called Yerlis, in the neighbourhood of Smyrna, and inland. Between the value of the first and last qualities there is a difference of from 50 to 60 per cent. Currants are grown only at Phokes.

These several descriptions of raisins appear in the market in an inverse order to their quality. The Yerlis come first at the end of July, those from Vourlah, Phokes, and Chesmé arrive about the middle of September, the Carábournou not till the end of September or beginning of October.

An acre contains about 2000 vines, and the produce of dry sultanas varies from 7 cwt. up to 30 cwt. per acre, in some cases rather more. This and many other sorts of Turkey fruit are cured in the sun, a slight sprinkling of oil being employed to prevent the too great evaporation of the moisture, and also to give the fruit, when packed and shipped, a better chance of preservation.

Muscateles or table raisins from Malaga are an article of large use, and have a more extensive range of quality than any other fruit. They are known as layers, bunch, and loose, the last description being, as the word implies, picked off the stalk.

EXPORT of RAISINS from SPAIN in KILOS.

1877	37,756,000	1882	41,779,000
1878	43,017,000	1883	35,897,000
1879	32,527,000	1884	30,158,000
1880	28,964,000	1885	33,226,000
1881	36,154,000	1886	38,646,000

IMPORTS of CURRANTS and RAISINS into the UNITED KINGDOM in CWTs.

Year.	Currants.	Raisins.	Year.	Currants.	Raisins.
1877	1,349,965	535,758	1883	1,026,584	588,309
1878	1,087,266	450,329	1884	1,202,844	511,870
1879	1,148,512	585,538	1885	1,128,383	591,234
1880	820,146	395,290	1886	843,425	505,383
1881	1,189,830	568,606	1887	1,097,001	654,637
1882	1,012,102	548,911	1888	1,020,380	590,000

Nearly all these imports are taken for home consumption; the aggregate value of these dried fruits reaches £2,400,000.

PRODUCTS OF THE ORANGE FAMILY.

Next to the vine in commercial importance for its fruit comes the Orange family. Although not exclusively a tropical fruit, the orange is found and flourishes throughout the eastern and western tropics. The latitude under which it is grown in Europe, Spain, Portugal, Sicily, and Malta, is chiefly between 36° and 40° ; also in New Zealand, New South Wales, and in Florida it grows between 25° and 30° . For the production of oranges all the countries coming within the tropical and subtropical zones are well adapted. They abound in the East and West Indies and Pacific Islands.

Formerly proximity to this country was an essential in the production of the orange and lemon for commercial purposes, and hence we derived our supplies almost exclusively from Spain and Portugal; but the facilities afforded by steamers now enable us to obtain oranges and lemons in a good condition from more distant quarters. They now reach us from Malta and Sicily, West Africa, Brazil, the West India islands, and the Azores.

The following figures give the imports of oranges and lemons into the United Kingdom:—

	Year.	Quantity.	Value.
		bushels.	£
	1865	1,566,745	..
	1875	2,861,719	1,336,247
	1880	3,658,799	1,463,019
	1885	4,356,739	1,481,010
	1886	4,371,405	1,480,708
	1887	4,857,414	1,560,116
	1888	4,879,995	1,464,640

The imports for 1886 were drawn from the following countries:—

Countries.				Quantity.	Value.
				bushels.	£
Portugal	..	..	..	114,999	46,759
Azores	..	..	..	133,290	43,521
Spain	..	..	..	3,347,157	1,108,410
Italy	..	..	..	631,947	228,208
Other countries	..	..	..	144,012	53,810
Total	..	..	..	4,371,405	1,480,708

The Spanish and Azores oranges are considered the best. Prices fluctuate a good deal, according to supply and demand.

The ORANGE, in the widest sense of the term (*Citrus aurantium*, Lin.), is a native of Southern Asia. It is a tree of great longevity, having been known to attain an age of 600 years and more. Any

specific differences to distinguish *C. aurantium* from *C. medica*, if they ever existed, are obliterated now through hybridization, at least in the cultivated forms.

Four varieties of citrons are described which are cultivated in Sicily, and fourteen varieties of the orange, and there are several kinds of lemons and limes both with sweet and sour juice.

The limit of the culture of the orange is almost about the same as the olive, except that, according to Schouw, it extends a little farther to the north. It crosses the northern part of Spain, the extreme south of Provence, traverses Italy a little above Florence, descends nearly to Greece, and, passing by the Isle of Cyprus, enters Asia. In France the limit traversed is the country where the mean temperature is 14° , the spring temperature $12^{\circ}\cdot5$, the summer temperature about 21° , and the autumn temperature 14° .

The orange, lemon, lime, citron, shaddock, and forbidden fruit, all belong to one genus, the *Citrus* of Linnæus. According to Lindley, there are fifteen distinct species, with a few varieties; Steudel* enumerates, however, twenty-five, besides numberless varieties. They are thought to be natives of the East, where they are found growing wild, and are not considered to be indigenous to America, although one native species is attributed to French Guiana. Six or seven of the choicest species are natives of China and Japan, and the rest of India, and other parts of Asia.

Risso, of Nice, in his large work, enumerates forty-three species and varieties of the sweet orange, thirty-two of the bitter and sour, five of bergamots, eight of limes, six of shaddocks, forty-six of lemons, and seventeen of citrons.

In Central India a peculiar variety of *Citrus aurantium* is under culture, producing two crops a year. The blossoms of February and March yield their ripe fruit in November and December, whereas from the flowers of July mature fruits are obtained in March and April. To prevent exhaustion, only alternate fruiting is allowed.

As a prominent variety of *Citrus aurantium* may be distinguished the bitter orange (*C. bigaradia*, Loisl.). This furnishes from its flowers the Neroli oil, so delicious and costly as a scent. The French are endeavouring to promote the manufacture of the essential oils of lemon and orange in their inter-tropical colonies, Guiana, Tahiti, and Martinique. The French settlements in the Pacific send millions of oranges to California, although 5,000,000 or 6,000,000 are produced there. The annual requirements of the San Francisco market are over 12,000,000, of which 5,000,000 are imported from Tahiti and Mexico. A part of the crop is made into an excellent spirit, and the rest are wasted. In Martinique many houses make large quantities of orange wine, which finds a ready sale in Turkey and Russia. The oranges employed for these diverse uses might be first made to yield their essential oil from the rind. Oil of oranges sells at about 7s. per lb., and oil of

* 'Nomenclatur Botanicum.'

citron or bergamot at 10s. to 25s. per lb. These high prices are likely to stimulate an industry which has hitherto been monopolized by Sicily. It is stated that orange flowers to the value of £50 might be gathered from the plants on an acre within a year. The rind of the fruit is used for candied lemon peel. It contains a bitter principle, hesperidin, and limonin, in the seed.

Of the sweet orange (*C. dulcis*, Volkamur), many kinds occur. The St. Michael's orange has been known to bear in the Azores, in sheltered places, 20,000 fruit on one tree in a year. Neroli oil is also obtained from the flowers of this and allied varieties. An infusion of the leaves of the orange, in the form of tea, is considered efficacious in fevers; and when amalgamated with the flowers, it acts as a stimulant, and is given as a tincture when its effects are required to be energetic. The seeds contain a fixed oil, of an amber colour, which is highly valued for reducing swellings, and as an excellent oil for the hair. It may also be used for the table. From the flowers an odoriferous perfume is extracted, and they constitute an excellent stomachic. In the mandarin orange (*C. nobilis*, Loureiro), the thin part separates most readily from the deliciously flavoured sweet pulp. There are large and small fruited mandarin oranges; the Tangerine variety is one of them.

The shaddock, or pumpelmos (*C. decumana*, Lin.). This fruit will exceptionally attain a weight of 20 lbs. The pulp and thick rind can both be used for preserves. *Citrus bergamium*, Risso. From the fruit rind of this variety bergamot oil is obtained, and also oil from the flowers. The Mellarosa variety furnishes superior oil, and exquisite confitures. All the varieties of the orange tribe may be raised from seed. Those thus raised will produce fine fruit, and if not suffered to grow to trees, may be used as stocks for budding. The bitter orange and the citron are, however, considered the best stocks for the sweet orange. Once fairly in growth, it requires only to be attended to, and plentifully watered in dry weather, with a supply of manure from the cowhouse. The orange may also be propagated by layers.

The CITRON, in the widest sense of the word (*C. medica*, Lin.), is indigenous to southern Asia, but is widely diffused. As a prominent variety may be named the real citron (*C. cedra*, Gallesio). From the acid tubercular fruit essential oil and citric acid can be obtained, irrespective of the ordinary culinary use of the fruit. A large variety, with thick rind, furnishes the candied citron peel or succade of Italy. Five hundred or six hundred tons of candied peel are said to be used in England. The cedrat oil comes from a particular variety.

The real LEMON (*C. limonum*, Risso). From the fruit of this is largely pressed the lemon juice, while the thin, smooth, aromatic peel serves for the production of volatile oil, or for condiments. The sweet lemon (*C. lunea*, Risso) includes the pear lemon, with large pear-shaped fruit. The rind is thick and pale, the pulp not acid. This variety serves for particular condiments. The juice

of this fruit is especially rich in citric acid. A large variety is the Rosaline lemon. Among the many cooling drinks for which American hotel-keepers have a *spécialité*, lemonade is not wholly forgotten. Their demands, indeed, give activity to a flourishing industry in the south of Europe. The lemon growers of Mentone depend greatly on American custom, which they almost entirely monopolize, as the lemons produced in the districts surrounding that port, being of a very superior quality, have the merit of bearing a long voyage uninjured, provided they are carefully packed previous to their embarkation. The lemons cannot bear the shock of removal in a cart, and are carried in baskets to the packing shed, where they are severally wrapped in silver paper, and laid in rows in the packing cases, care being taken to pack them loosely enough to avoid bruising the fruit, and yet tightly enough to prevent their becoming displaced during the voyage. The American steamers engaged in this trade carry 5000 cases; each case contains 500 lemons, and therefore every vessel conveys 2,500,000 of this useful fruit to the United States.

The real LIME (*C. Limetta*, Risso). The best lime juice is obtained from this variety. In several of our colonies, especially Montserrat, Jamaica, and Dominica, attention is now given to the production of this article.

The requirements in the culture of the lime are very simple, and consist mainly in keeping the trees free from weeds, allowing them to spread freely, and irrigating during the dry months. No pruning is required, but merely the removal of exhausted and dry branches. Although the lime tree delights in a good soil, and is strengthened by a degree of moisture somewhat above the average, being a hardy plant it will thrive and be fruitful in soils and situations that may prove too poor and dry or exposed for coffee and cacao. Protracted drought is particularly fatal to the lime tree. The process of extracting and preparing the lime juice is most simple, consisting of submitting the fruits to the pressure of a mill of no great power, and boiling down the resulting juice (which may be kept a great length of time without deteriorating) to the required density, and putting it into casks for exportation. The density which has been found most satisfactory is reached by boiling down to one-eighth the original volume. In Jamaica, lime juice has been, of late years, concentrated and shipped to America, to be used in fixing certain dyes. From Montserrat 400 to 500 puncheons of lime juice have been shipped in the year.

In an account of the Island of Montserrat, published by Messrs. Sturge in 1882, they give an account of their lime tree plantations there:—

“The first lime tree orchards were planted in 1852 by Mr. Burke, an enterprising planter then living in the island; but the speculation was at first by no means profitable, as this is an enterprise that involves a large outlay of capital, which is for a number of years unproductive, and even then only remunerative on a large scale, although the low rate of wages and extent of unculti-

vated land in a salubrious climate, render the island of Montserrat particularly suitable for the purpose.

"The lime tree grows wild in many tropical countries, but does not flourish even so far north as the Azores. It is a thorny, bushy, evergreen tree, with handsome, dark-green leaves. These are so fragrant that they are universally used in the West Indies to perfume the water in the finger-glasses at dessert. The small white flowers resemble orange blossom, and the scent is equally delicious. The lime flourishes best in light soil near the sea, and comes into full bearing about seven years from the planting of the seed.

"The plantations of the Montserrat Company already cover more than 800 acres, and contain 160,000 trees. These are generally planted 15 feet apart, and the high road passes through them for a distance of 2 miles. No more beautiful sight can be seen than these orchards when the trees are laden with their bright fruit, and at the same time the air is pervaded by the luscious fragrance of the blossom."

The quantity of oranges and lemons we receive in the United Kingdom has doubled in the last ten years. Our imports in 1875 were under 3,000,000 bushels, of the value, in round numbers, of £1,300,000, and now nearly 5,000,000 bushels are received, but the selling prices are much lower.

Algeria.—The orange grows in all parts of this French colony which are not above 2000 feet elevation, especially in sheltered situations, and acquires an excellent flavour and aroma. Besides the orange proper, the citron and lemon, the cedrat and the pumpelmos, are grown. Among the oranges are numerous varieties, among which the best known are the Portugal, Chinese, and mandarin, the bigaradia, or bitter orange, useful for making orange-flower water, essence of bergamot, mellarosa, &c. The fruit of the orange tribe is becoming yearly an article of larger importance.

The Azores.—Previously to the year 1842, from 20,000 to 30,000 boxes of oranges were annually exported from Fayal; but owing to the attacks of the insect *Coccus hesperidum*, which destroyed the trees, for several years no oranges were produced. The insects have, however, been gradually disappearing, and the exportation of oranges is augmenting.

The exports from the Azores between 1851 and 1857 averaged about 130,000 boxes. The box may be said to hold about three bushels. The export of oranges averages 800,000 to 900,000 bushels per annum.

The trees are planted at a distance of from 25 to 30 feet apart, and the ground sown with lupins, which are considered by the Portuguese to be a favourite food of the orange trees. Seven years elapse from the time of bearing before the orange trees come into full bearing, during which space of time, more especially among the poorer class of proprietors, the garden is sown with melons, water melons, and other vegetables. The trees are pruned every year, so that by thinning out their superfluous branches a free

circulation of air is allowed, which is required for the proper ripening of the fruit. The orange grounds at the Azores vary in size from 1 to 60 acres, and they are rarely occupied only by orange trees. The Portugal and mandarin orange are those principally grown.

Some shipments are made in what are termed Russia boxes, three of which are equal to two large or London market boxes. They are also shipped in half or flat boxes, third, and quarter boxes. The shipping season extends from October to April. There is occasionally a considerable crop of what are called summer oranges (*redolita*), which are very inferior, and scarcely cover prime cost and freight when sold in the English market. The oranges which ripen in the summer months are not only deficient in sweetness and flavour, but are far more susceptible of damage in transport.

Italy.—The following shows the progress of the export trade of Italy in the fruit of the *Citrus* family, oranges, bergamots, and lemons:—

	Kilos.		Kilos.
1874	70,403,000	1885	152,008,000
1884	173,252,000	1886	124,659,000

New South Wales.—Oranges and lemons are grown without difficulty in this colony where the soil is heavy; they do not thrive at Sydney, on account of the sandy soil. In favourable situations they are as fine as can be wished.

The orange only succeeds in a very small portion of the colony. The produce in these districts was, in 1882–83, about 4,000,000 dozen, viz.:—

	Dozen.
Parramatta	3,169,808
Campbelltown	36,000
Penrith	100,000
Windsor	600,000
Maitland	54,000
	3,959,808

In 1888 there were 7734 acres under oranges in the colony, and the yield was 8,704,677 dozen, valued at £90,674.

The mandarin orange, a celebrated Chinese fruit, is said to be better at Sydney than it is at Canton. It is a very beautiful dark orange-coloured fruit, with a highly-perfumed rind, scarcely thicker than brown paper, and not adhering to the pulp, which is exceedingly sweet, and of a different flavour to any other orange.

A considerable portion of land is devoted to the orange, particularly in Cumberland, where a fine market and an accommodating railway are to be found. Thousands of cases come down to Sydney annually from the Parramatta orangeries, and are shipped to Melbourne, South Australia, Tasmania, New Zealand, &c. The profits of orange-growing are, when the practical management of the tree is understood, very considerable; but in many cases the trees have been exhausted by being allowed to bear heavily year

after year, without any attempt to recruit their jaded powers by the application of manure. The plantations are generally young, and the trade in oranges and lemons is likely to assume large proportions; but the growers will have to master the principles of drainage and manuring, and apply them, before they will be able to preserve their trees in a healthy state.

A paper by Dr. George Bennett, F.L.S., "On the Introduction and Cultivation of the Orange in New South Wales," published in the New South Wales Catalogue for the Paris Exhibition, 1867, and in the Intercolonial Exhibition Official Record, Victoria, 1866, may be consulted with advantage; also a treatise on Orange Culture by G. E. Alderton, published at Wellington, New Zealand, in 1884.

In the immediate vicinity of Sydney there exist orange groves as extensive and magnificent as any which have ever gladdened the eyes of travellers in Spain or the Azores; the orange and other members of the citron family grow luxuriantly in the valleys of the Hunter and the Clarence; and, indeed, all along the coast districts of New South Wales, over a belt of country 300 miles in extent. Some of the trees in the Parramatta orangeries, half a century old, have attained a height of 35 feet, and their branches a circumference of nearly 100 feet. Sometimes a single tree will produce as many as 12,000 oranges in a year, and the small variety known as the mandarin has borne 4200 upon one tree during the season. During the month of October, oranges of every kind come into the Sydney market in enormous quantities, and at that season 6000 dozen per week are often exported to Melbourne alone. Lemon trees grow in the same orchards with the orange, and are so loaded with fruit as to require support. In this congenial climate every species of *Citrus* flourishes, the seedless St. Michael's, the large and luscious "navel" orange, the little cumquat from China, and, equally well, the citron and the shaddock. From £50 to £1800 are realised by the proprietors annually, as the incomes from the produce of their orange plantations, according to the extent of fruit-bearing trees. The price paid by the dealers on the ground for the fruit varies from 4d. to 2s. per dozen, according to the kind and quality.

Few persons visit Sydney without seeing, or at least without a desire to see, the Parramatta orangeries. The location is some 16 miles from Sydney, and about the same distance from the sea in a westerly direction. As soon as a landing is effected there one finds that he is in a fruit country. Oranges abound everywhere. The goods traffic of Parramatta is made up largely of oranges. Orange boxes, full and empty, meet the eye in all directions. Every second man, woman, and child, are eating oranges.

Australia has commenced to send oranges to England, for there the fruit ripens at a season of the year when the trees in the more northern hemisphere have ceased bearing, and the orchards of Sydney and Queensland can furnish us with shipments throughout the summer months, when the Continental fruit now fails us.

The orange is a surface-feeding plant. Where old trees are

growing, the surface of the soil is an absolute network of fine rootlets. These rootlets should not be injured in cultivation; hence the use of the Dutch hoe. To keep up the fertility, guano is extensively used. As soon as a tree shows signs of languishing it gets a dose of guano mixture, say a couple of pounds. This is spread around the tree on the surface of the land, and is then touched in with the hoe. Both trees and fruit, by this treatment, are beautifully clean.

Concerning the varieties of oranges cultivated, seedlings are most in favour. Next to them are grafts upon the bitter orange stock. The lemon, as a stock, is considered the cause of deterioration in the orange, and the source of scale and other diseases. In selecting seed for sowing, the planter chooses the fullest and finest oranges; he will have nothing to do with refuse fruit for such purposes. The seed is sown wide apart, that the young plants may have space. The system of raising seedlings in close rows is found to cramp their growing capabilities. All through there is a desire to get large, vigorous, perfect trees, and to that end it is not considered desirable to force them into early bearing. Seedlings take many years (five or six) to come into bearing, but they make the finest trees, and that is considered all-sufficient for the Parramatta growers.

South Australia.—In this colony the orange thrives wonderfully well. Whole acres of healthy trees, laden to the very ground with golden fruit, may be observed around Adelaide, and in many parts of the country to the north and south of the capital. In the month of June the market price of oranges in Adelaide is 3*d.* a dozen. Every year somewhere about £50,000 worth of oranges are exported from New South Wales and South Australia to Victoria, and other colonies where the cultivation of this agreeable fruit does not appear to be attended with much success.

It is a good many years since the first orange trees were planted in South Australia, and although now there are considerable plantations, and every year numbers of young trees are coming into bearing, some time will elapse before the colonists there are able to supply their own consumption of that most delicious of fruits. Thousands of pounds are sent away every year for Sydney oranges, without which not more than half the local demand that exists could be supplied. In regard to quality, the fruit produced by the local growers bears favourable comparison with that received from the sister colony, and this will be even more the case as the trees get older and the horticulturists become better acquainted with the proper methods of orange culture. Lieutenant Field, R.N., is said to have introduced the orange tree here early in 1837; others state that the first trees were planted by the late Mr. George Stevenson in the year 1840, or thereabout, at North Adelaide, and they are, therefore, now about 35 years old. One of them has been known to yield 190 dozen of oranges, which is the largest authenticated yield taken from one tree in the colony, although several of those at Ashford are computed to bear 150 dozen and upwards. When the success of Mr. Stevenson's experimental

planting became known, several other colonists, without much delay, set to work to secure themselves more or less extended plantations of a tree of such high European reputation as the orange, so that there are now a good many hundreds of trees in bearing; but, for a variety of reasons, comparatively few have attained anything like the productiveness for which the tree is credited in Spain and other parts of southern Europe, where trees are spoken of that yield some thousands of dozen of fruit in a year.

United States.—Oranges are cultivated in Florida as easily and produce as quickly as the apple, and yield in full bearing from 1000 to 2500 per cent. per acre to the owner on the ground at current prices, and with but trifling labour. The superior ripe fruit must end ere long in supplanting the half-ripe foreign fruit of which now there are nearly 1,000,000,000 of oranges and lemons imported into the United States annually, to New York alone 500,000,000, or half of the entire amount.

In Florida, where labour is worth a dollar a day, great attention is bestowed upon orange culture, and full-bearing orange trees are valued at £20 each.

Green peas, strawberries, tomatoes, &c., can be grown the winter through in the open air, in profitable union with the orange culture. The banana, guava, and breadfruit also thrive there.

Thirty or forty vessels are constantly engaged in carrying fruit to New York from the West India Islands. They draw their supplies from Jamaica, Trinidad, Cuba, and the Bahamas. West Indian oranges are preferred for their flavour to those brought from Europe. They begin to arrive in October, and are most abundant in January and February; Mediterranean oranges are not received extensively until April or May.

Oranges and lemons, with more or less protection, grow luxuriantly along and near the line of coast of California for 500 miles,

In 1874 the county of Los Angeles had 90,057 orange trees, which furnish from 1000 to 3000 fruit each, and these sell readily at 2*d.* a piece. The tree takes 12 years to come to maturity, and the lemon 16 years. Many of the latter trees yield £20 profit yearly to their owners. There are in the State of California 13,606 lemon trees.

Jamaica.—Several well-kept plantations are springing up in this island, which will no doubt in time yield fruit superior to any now exported; but the trees yielding the bulk of the present export of oranges from Jamaica are self-sown seedlings, growing in cattle pastures, or in the neighbourhood of coffee and provision fields, and they receive little or no cultivation. The value of the oranges exported from Jamaica now exceeds £50,000 per annum.

As the orange trees grow everywhere in the island without cultivation, the oranges produced cost nothing.

A noteworthy feature is observable in the fact that Havana, hitherto the chief seat of this trade, has now yielded the precedence to Kingston. But it is still more important to record the fact that the Jamaica oranges fetch a higher price in the New York markets than any other imported oranges, and they are yearly increasing in popular favour.

From this geographical position a large proportion of the fruit of the West India Islands finds its way to the United States and Canada, where there are over 60,000,000 of people, with all of whom fruit enters largely into their daily food.

Bahamas.—The quantity of oranges shipped from the island of New Providence to the United States, in the season of 1875, was about 2,000,000, in 20 vessels, 6 of which took 150,000 or more per load. The largest cargo was 320,000 (equal to 1280 barrels). The trade is conducted in schooners, with the exception of the generally smaller quantities that are carried away by the steamers which call at the port. Eight of the 20 vessels carrying oranges were steamers. As a barrel is stated to hold, on an average, 250 oranges, the number shipped to the States from Nassau is equivalent to 7594 barrels. The 'Nassau Times' states 2,000,000 were also shipped to the States direct from Abaco, Andros, Eleuthera, and other of the islands, and the total shipped from the group was about 4,000,000 fruit (equal to 16,000 barrels), estimating the average price at 30s. per 1000, worth £6000 to the growers. Adding the smaller shipments to London, along with grape fruit and shaddocks, it believes the crop of the season would realize £7000. Extensive orange orchards having been lately planted in the islands, the trade is expected to soon double itself in quantity, increasing further by the greater productiveness of the trees as they approach full bearing; but with such increase a decrease in price is considered possible.

In the French Pacific Islands there are about 8000 acres covered with orange trees, which produce about 15,000,000 fruit. In Tahiti oranges grow almost wild, and about 6,000,000 or 8,000,000 fruit are yielded annually.

Five or six millions used to be shipped to California, but the orange trade between Tahiti and San Francisco has declined in consequence of the progress making in the culture, and the abundance of the produce of Los Angeles and the south of California.

Italy.—A large trade is carried on between New York and Italy in green fruit. The steamers employed make the voyage in about twenty-eight days, and carry from 13,000 to 15,000 boxes. The box of oranges contains on an average 226 fruit; the chest, which is a box and a half, would have 340.

The following were the quantities shipped from Italy to the United States in the season of 1884-85 from:—

Provinces.	Oranges.	Lemons.
Catania.. ..	63,392	103,564
Messina	570,884	376,137
Palermo	404,616	1,176,154
Sorrento	122,583	32,686
Milazzo	6,186	8,204
Total	1,167,661	1,696,745

A full-grown orange tree yields from 500 to 2000 fruit annually and arrives at the bearing state in three or five years, as does the lemon tree; both grow luxuriantly in most soils. The plantations (in the Mediterranean countries) are called gardens, and vary in size, the smallest containing only a small number of trees, and the largest many thousands. The fruit is gathered in baskets lined with canvas, the basket being held by a strap attached, and passed around the neck or shoulders. From the garden the fruit goes to the packing magazine, where it is removed from the boxes in which it was placed in the gardens, and repacked for shipment by experienced female packers, after having been carefully assorted by women, and wrapped in separate papers by young girls. As many as 500 persons (mostly women and children) are employed by some of the fruit growers in their gardens and magazines, in gathering, sorting, and packing for shipment, the wages paid them varying from 9 to 16 cents a day. In sorting, every fruit that wants a stem is rejected. The boxes are then securely covered, strapped, and marked with the brand of the grower, when they are ready for shipment. Twenty years ago, this trade was trivial in its commercial characteristics, or the inducements it offered to capitalists. Now it is progressing with giant strides into prominence, and is a considerable source of revenue to the Italian Government.

Sicilian lemons, which were formerly very plentiful, have been getting scarce of late years, and the island can with difficulty supply the demand for the United States, which is always large. The consequence is that prices have risen considerably, and essence of lemon, which used to be 8s. per lb. is now 19s.; while boiled lemon-juice is nearly double its former price. Leghorn was the great seat of the candied citron trade, about 5000 boxes (1000 to 1100 tons) being exported in good seasons. But the trade has declined, as more sugar is lost in making the citron than the Government allows drawback on.

The exports of oranges, bergamots, and lemons, are given in the Italian returns in kilogrammes of 2½ lbs. The following figures will serve to indicate the course of trade:—

			Kilos.				Kilos.
1862	..	..	45,829,894	1882	..	..	119,439,000
1872	..	..	87,526,000	1883	..	..	124,659,000

Spain.—The export of fruit forms an important branch of Spanish commerce, 650 to 800 million oranges being exported annually. Malaga is the centre of the dried fruit trade; Seville, Valencia, and the Balearic islands, for oranges and citrons. The orange crop in the Balearic islands is beginning to show some signs of improvement, and it is hoped by the growers that the worst of the fatal disease which destroyed the trees is over, but it must be some years before the exports in this fruit return to their former figures.

Citrons are exported from Malaga in their green state, in cases weighing 80 kilogrammes, half cases, and quarter cases, each fruit

being carefully wrapped in paper. They are chiefly shipped to the United States. The localities of production are Pizarra, Alora, and Coin, in the neighbourhood of Malaga. Orange peel is also shipped, which is largely consumed in Holland, France, and Germany, chiefly for making liqueurs and syrups.

The export of oranges from Spain is shown in the following return in kilogrammes :

	Year.	Quantity.	Value.
			£
	1882	116,668,000	1,166,700
	1883	98,671,000	868,320
	1884	104,565,000	922,800
	1885	71,381,000	571,040
	1886	81,573,000	652,600

Greece.—The Isle of Naxos, in Greece, ships to England more than half a million citrons annually, but could easily export several millions. They are collected and shipped as they ripen, the want of labour alone prevents their being preserved on the spot. The culture of citrons has been abandoned for cedrats. The gross export of oranges and lemons from Greece has rather fallen off of late years.

THE PINE-APPLE.

The PINE-APPLE (*Ananassa sativa*, Lindley) is one of the most esteemed tropical fruits. Formerly great attention was given to forcing this fruit in England; but the large importations now made at certain seasons of the year have increased the foreign supplies, and somewhat reduced the price of home-grown fruit; still it is brought to great perfection by our gardeners.

The pine-apple is indigenous to South America and some of the West India islands, but has become so perfectly naturalized in many parts of the hot regions of Africa and Asia, that it has been thought to be likewise a native of those countries. It is now found in an almost wild state in most parts of India and Ceylon, and is abundant also in the Malay Peninsula, the Straits Settlements, China, and the Islands of the Eastern Archipelago.

The pine-apple is no doubt indigenous to Jamaica, where an inferior kind, known as "cowboy macca," is still found wild. The pine-apple is incorporated in the arms of Jamaica, and certainly nowhere, except at Pernambuco or Singapore, can pine-apples of such size and delicacy be grown as in some parts of the island. Antigua is noted for its pine-apples, the Pitch Lake of Trinidad has at least a local reputation, but the Bahamas export more pine-apples in the fresh and preserved state than any other part of the world. The chief supply of pine-apples for the English market at present comes from Madeira, the Canary Islands, and the Azores.

The varieties cultivated are very numerous. In the Transactions

of the Horticultural Society of London, for 1835, Mr. D. Munro gives a list of fifty-two kinds, which fruited in the Society's garden at Chiswick. Of these the following may be enumerated: The Queen, the sort generally grown by the gardeners for the London market; the Moscow Queen, an excellent variety; the black Jamaica; the brown Sugar-loaf, Ripley, St. Vincent, and black Antigua, excellent and highly flavoured pines; Enville, a handsome fruit; Lemon Queen, and white Providence, a handsome showy kind. The Trinidad or La Brea pine, is a very fine large fruit, some reaching at times to 28 lbs. weight.

Bahamas.—The pine-apple is grown for export in the Bahamas in fields of large size, and of considerable extent. The cultivation of this fruit is carried on chiefly at Eleuthera, Abacos and San Salvador, but the plants are also grown on some of the other islands. Of the several varieties of pine-apple, only two are here considered profitable to cultivate for export—the Spanish scarlet, and the sugar-loaf. The former was introduced into the Bahamas from Cuba in 1850, and is now the leading variety of commerce; the latter, a very luscious fruit, is exported principally to England. As the voyage is a long one, the plant is cut off at the root, and plant and fruit are shipped unseparated. They are cut in a green state in order to keep during the voyage; arriving in a sound state, they pay very handsome profits. In 1872, 590,665 dozen of pine-apples, valued at about £42,000, were exported. In 1874 the quantity shipped was valued at £40,066, the sale of one cargo in London being as high as £1000, by one of fourteen vessels engaged in the trade. In 1880 about 340,000 dozen were exported; in 1881, 363,000 dozen; and in 1885, 455,965 dozen, valued at £50,847.

The cultivation of the pine-apple for export was formerly confined almost exclusively to the island of Eleuthera and its keys or islets, it being erroneously supposed that the soil there was alone adapted to the growth of the fruit; but of late years the culture has been extended to many of the other islands, as well as New Providence, where large quantities are grown and annually exported to various quarters, and, meeting with a remunerative sale, afford both growers and shippers very handsome returns.

The simple mode of testing the capability of the soil for growing the pine-apple in the Bahamas is by running a knife down it in dry weather, and if any portion of the earth adheres to the knife, it is considered by the planter an evidence of the suitability of the soil.

In the island of San Salvador there are fields of pine-apples, containing 25 to 60 acres in a block. In good seasons the yield is about 800 dozen per acre.

The season for shipments of pine-apples is from April 15 to July 15. It is estimated that from 75 to 100 ship-loads of fruit are sent off during the season; about 40,000 pine-apples make an average cargo, the total exports reaching 4,000,000 to 5,000,000 pine-apples during the season. The average price paid for the

fruit is about 1s. 9d. per dozen for first cuttings, 1s. 6d. for second, and 1s. 3d. for third.

An acre of good land will easily support 6000 plants of the sugar-loaf variety, or about 5000 of the scarlet variety, and there is a large quantity of land in the Bahamas eminently adapted for the purpose of growing pine-apples, which has never yet been cultivated. The price of good land varies between £1 to £4 per acre, and depends upon the size, the fertility of the soil, and its proximity to a suitable place for shipping the fruit, and as much of the fruit is taken on board vessels which call along the coast during the season, a plantation which borders upon some cove, bay, or good anchorage, is a valuable one. The average life of the scarlet pine is three years, and that of the sugar-loaf about five. The weight of the fruit in the Bahamas is from 3 to 3½ lbs.

A field is generally gone over three times during the season, affording three grades of fruit, called first, second, and third cuttings. The scarlet variety ripens a month or two earlier than the sugar-loaf. Owing to the sharp serrated leaves of the plant, the gathering of the fruit is a tedious and difficult matter, the men, women, and children engaged in the work being obliged to wear heavy canvas leggings, and gloves with gauntlets, to protect themselves against the sharp spikes of the plant. The pine-apple plants furnish but one regular crop during the year, although the local markets are seldom without pine-apples for sale. The first cuttings of the scarlet pines are made about the middle of April, and the last about the 1st of July. The sugar-loaf pine is at maturity during July and August. The shipping season is one of great activity in the Bahamas, for when the fruit is ready for the knife, it must be cut, and hurried with all speed to market, or it will be lost.

The average passage to London is thirty-one to thirty-five days. When ripe, they are liable to decomposition on the passage, and are therefore shipped in a green state, and ripen on board. Sometimes on arrival, if not sufficiently ripe, they are placed in warming rooms. Rainy and damp weather is very injurious to pine-apples, and if combined with a long passage, will render them worthless.

The number of cargoes usually arriving each season is nine to eleven, and the vessels bring about 48,000 pine-apples each; 1300 pines weigh about a ton. The hold of each vessel is fitted with three or four racks or battens of wood, supported by upright posts, thus forming three or four shelves or platforms the entire length and depth of the hold, with the exception of the centre, where a passage is left from stem to stern for admission. The fruit is then placed, with a portion of its foliage on, to protect it from bruising, in layers of about four pines deep, upon racks, which are built to prevent the great pressure that would otherwise be upon the lower portion of the fruit.

Within the last few years several factories for preserving pine-apples have been started in the different islands. In 1872, 494,213 cans of pine-apples, valued at £8190, were preserved and exported,

chiefly to the United States. In 1873 the value of the canned fruit shipped was £14,700.

One factory alone in Nassau consumes about 25,000 pine-apples per diem, and 200,000 to 300,000 cans of fruit are put up during the season. In 1881, 287,000 tons were shipped. The wages paid to the work-people are at the rate of about 2s. a day for men, 1s. for women, and 6d. for children, and even lower wages are paid to plantation hands.

There is a large local demand of fruit for tinning, and 113,000 dozen were bought by one firm at Nassau, filling more than 1,000,000 cans with sliced pine-apples. For canning, the pines are required fully ripe, and to average 15 inches in circumference, none to be less than the usual shipping sizes, 13 inches and 12 inches for first and second cutting scarlet, and 12 inches and 11 inches for sugar-loaf.

The operation of peeling and slicing is performed on tables in the yards of the waterside premises, over which an awning is placed to protect the operators from the influence of the sun. About 20,000 pine-apples are peeled and 12,675 cans filled in a day. The cans are carried to the warehouse on wooden trays (each containing fifteen) to be immersed in syrup. The tops of the cans are soldered on, and they are lowered in an iron framework, four hundred and five hundred at a time, into the steam boiling vats. After boiling, the cans are perforated at the top to allow the steam to escape. They are then hermetically sealed, and spread over the yard to cool. Each can of fruit, before the syrup is added, weighs 2 lbs.

As it does not seed, this plant is propagated by suckers. Occasionally the crown of the fruit (the small aggregated mass of leaves) is planted; but as this requires three years to arrive at fruit-bearing, and the suckers only take twelve or eighteen months, the suckers are preferred for propagation. They should be planted in rich red soil, about 18 inches apart, and weeded every three months. Careful cultivation greatly improves the size and flavour of the fruit. In the Botanical Gardens of Singapore the enormous golden yellow fruit form a remarkable contrast to the puny pine-apples which appear on the London fruit-stalls. A field of wild pine-apples, such as cover many of the islands in the Straits of Malacca, is almost as inaccessible as a field of cacti, and the leaves, with their sharp points, are a formidable obstacle to the naked legs of the marauders who desire to obtain the fruit.

New York now almost monopolises the trade in pine-apples from the West Indies. In 1854, 20 cargoes, averaging 80,000 dozen per ship, were imported there from Cuba, 20,000 dozen from St. Bartholomew, and 200,000 dozen from the Bahamas. The shipments from the Bahamas in the three years ending 1870 averaged 290,000 dozen, the great bulk of which went to the United States. In 1871 there was a much larger shipment, amounting to 449,418 dozen, valued at £41,876.

The prices for pine-apples range from 3s. to 4s. per dozen, plantains and bananas, 2s. to 3s. the bunch, oranges 4s. 2d. the

100. In 1872 pine-apples in New York fetched 15 to 17 dollars the hundred.

There are numerous varieties of pine-apples; one of the best is said to come from Guayaquil. Nichau, one of the Sandwich Islands group, produces an exquisite fruit, such as is rarely met with either in the East or the Pacific.

Although the culture of the fruit for export was at first restricted to the Bahamas, now Jamaica, St. Bartholomew, Trinidad, the Azores, and other quarters, have entered into the trade. The first shipments were made in 1842 to Liverpool from the Bahamas.

Jamaica.—The following varieties of pine-apples are grown in the Hope nurseries, Jamaica, there being a great demand for suckers of the best kind:—

White Ripley, Black Ripley, Sugar Loaf, Prince Albert, Montserrat, Cuban, Providence, Scarlet (Queen), Trinidad (Pitch Lake), Black (Antigua), Queen, Lady Beatrice, Smooth Cayenne, Thompson's (smooth), Cayenne, Moscow Queen, Lord Granville, and Enville Queen. The best and most profitable kinds are said to be the Ripley, Black Antigua, Black Jamaica, Charlotte Rothschild, and British Queen. In 1884 a fine selection of the best English pines from Windsor Castle and Lord Carrington's nurseries were introduced into Jamaica, and have done well. In 1886 the value of the pine-apples exported was £1434, against 14,070 dozen shipped in 1884, value £2110.

Notwithstanding the advantages possessed for the production of this fruit, as well as the existence of a fortnightly line of steamers, plying between Kingston and America, where the demand for this and other fruits is unlimited, it is a matter of notoriety that the largest plantation of pines is in extent not more than about a quarter of an acre, and probably the five-acre plantation will comprise an area equal to the whole extent under cultivation in the locality. Choice pines from this district are sold in Kingston at from 9s. to 12s. a dozen. The price realized in New York for the best Jamaica pines is upwards of 1s. each. It will, therefore, be a moderate estimate if each pine is valued at 6d. In the Bahamas 20,000 suckers are usually planted to the acre; but this appears excessive overcrowding, and as a consequence the plants and fruit must receive a constitutional check in their maturation. The distances apart at which they are planted at Hope, are $3\frac{1}{2}$ feet between the rows, and $2\frac{1}{2}$ feet in the rows; this gives 4840 plants to the acre. Out of this number it may be safely computed that from the first crop, sixteen or eighteen months after planting, 4000 fruit will be obtained from each acre; considerably more would be procured from the second and third years' crops from the suckers produced around the parent plant, owing to sufficient space being provided for each plant. Now, estimating the return from each crop at 4000 pines, the result, at 6d. each, gives £100 per acre. The pine fields ought to be cleaned five or six times a year, each cleaning costing say £1 an acre, or £6 for the year; and this constitutes the whole cultivation.

Azores.—The pine-apple is now being cultivated with energy in

St. Michaels. The produce of the recent cultivation having realized very considerable profits in the English market, and the quality being recognized as superior to those of foreign growth generally, conservatories on a large scale have been constructed. The pine-apple of large size and of first quality now returns the grower from 16s. to 20s. each, which is a remuneration of 35 or 40 per cent.; and some choice specimens have been sold for as much as 60s. each.

They attain to a greater size than those received from the West Indies, some weighing 12 to 13 lbs. having come to hand. Great care is taken in packing them, to secure their arriving in England in sound condition. The stalk is cut several inches below the fruit; an ordinary large-sized flower-pot is then filled with mould, into which the stalk is inserted in such a manner that a casual observer would almost take it to be the way it was grown. Each pine is then put into a skeleton wooden case made just large enough to hold it, so that it can be safely handled without the risk of being bruised or injured, the pine itself being frequently wrapped round with paper as a further protection.

India.—The pine-apple is said to have been introduced into India by the Portuguese in 1594, and now grows abundantly at the foot of the Himalayas and in Assam. It grows in thickets near Rangoon, while in the Tenasserim provinces the plant has become so naturalized as to appear indigenous. A bag made on the Khasia hills, in Assam, of pine-apple fibre, was presented by Dr. Wallich, as far back as 1836, to the local Agri-horticultural Society. He mentions the enormous quantities of pines grown on that range, and that the plant appears as if it were quite a natural production. In the Tenasserim provinces the fruit is so abundant as to be sold in the months of June and July at 2s. the boat-load. The natives do not seem to be acquainted with the fibre yielded by its leaves. Some attention is being given to the culture of this fruit in Queensland, as there were 86 acres returned under culture with it in 1876.

There are between 7000 and 8000 acres under culture with pine-apples in Cochin China, with about 10,000 plants to the acre. Planted 2 feet apart each way, an acre will have 10,890 plants; $2\frac{1}{2}$ feet apart, 6960; 3 feet apart, 4840 plants. Thus, any one may calculate what an acre of pine-apple means, presuming, of course, that the plants are not allowed to be overgrown with weeds, and that the sort is good. The first crop of one pine-apple to each plant will be reaped about eighteen months after planting; in the succeeding year the plant throws out suckers and thus produces from the one root two or three pine-apples.

In Ceylon there are about 9000 acres covered with pine-apples.

Pine-apple Fibre.—The plant affords fine foliaceous fibres of practical utility from the leaves, which are about 3 feet long by $1\frac{1}{2}$ inches to 2 inches wide, strongly edged with spines. These may all be worked when the fruit is cut, the plant being perpetuated by shoots from its base. Two skeins of the pine-apple fibre were sent by the Court of Directors of the East India

Company to the Society of Arts, for a report on their properties, so far back as January 1836, but the specimens were too small for trial of their tenacity.

From some tests on the strength of this fibre when made into cordage, conducted at the arsenal of Fort William, on a rope of $3\frac{1}{4}$ inches in circumference, it appears to be remarkably strong. The Government proof is, that a rope of this size should bear a weight of 42 cwts.; but it bore no less than 15 cwts. more, that is, it broke with a weight of 57 cwts., proving incontestably that pine-apple fibre possesses strength for cordage as well as fineness for textile fabrics.

The pine-apple grows in great abundance in the Philippine Islands, but produces only a small dry fruit. We require, however, more precise information to enable us to determine whether this is actually the plant escaped from cultivation. Mr. Perrotet, of Pondicherry, considers it a distinct species, and has named it *Bromelia pigna*, from the Spanish name *pigna*, or *pina*, signifying a cone.

In preparing the fibre for weaving, the fruit is not allowed to ripen early; its removal causes the leaves to increase considerably both in length and in breadth. A woman places a board on the ground, and upon it a leaf with the hollow side upwards. Sitting at one end of the board, she holds the leaf firmly with her toes, and scrapes its outer surface with a potsherd, not with the sharp fractured edge, but with the blunt side of the rim; and thus the leaf is reduced to rags. In this manner a stratum of coarse longitudinal fibre is disclosed, and the operator, placing her thumb-nail beneath it, lifts it up and draws it away in a compact strip, after which she scrapes again until a second fine layer of fibre is laid bare. Then turning the leaf round, she scrapes its back, which now lies upwards, down to the layer of fibre, which she seizes with her hand and draws at once, to its full length, away from the back of the leaf. When the fibre has been washed, it is dried in the sun. It is afterwards combed with a suitable comb, like a woman's hair, sorted into four classes, tied together, and treated like the fibre of the *lupi*. In this crude manner are obtained the threads for the celebrated web *nipis de pina*, which is considered by experts the finest in the world.

In the Philippines, where the fineness of the work is best understood and appreciated, richly embroidered costumes of this description have fetched about £200 each.

This fine muslin-like fabric is embroidered by the nuns of the convents in Manila with great skill and taste. Beautiful specimens of this pina muslin were sent to the first London International Exhibition, and to subsequent Exhibitions. It is sometimes, but erroneously, called grass-cloth. With a magnifier the fibres may be seen to be very numerous and fine, but not twisted at all, as in grass-cloth or the finest muslins and cambrics. One of the coarser fibres may be subdivided into threads of such fineness as to be barely perceptible, and yet sufficiently strong for any purpose.

The manufacture of the pina fabric is carried on in the metro-

politan province of Tondo. From the extraordinary facility with which the pine-apple is grown in the vicinity of the equator, it seems almost certain that by the application of European skill to the process of separating the fibre from the pulpy matter of the leaf, a valuable raw material composed of it might be obtained for the factories of Europe. The fibre by the hackling process could be rendered fit for the finest fabrics. The leaf consists of two different structures: the upper side being of a soft or pulpy character, easy of removal; and the under side, of a harder or more ligneous nature, and more difficult to separate. These two external bodies hold the fibre between them.

In the Straits Settlements the Chinese labourers have taken kindly to this new and promising branch of industry. The process they adopt in preparing the fibre appears to be much the same as that pursued in the Philippines, and is thus described in a Singapore paper:—

“The process of extracting and bleaching the fibre is exceedingly simple. The first step is to remove the fleshy or succulent side of the leaf. A Chinese, astride on a narrow stool, extends on it in front of him a pine-apple leaf, one end of which is kept firm by being placed beneath a small bundle of cloth on which he sits. He then, with a kind of two-handled plane made of bamboo, removes the succulent matter. Another man receives the leaves as they are planed, and with his thumb-nail loosens and gathers the fibres about the middle of the leaf, which enables him by one effort to detach the whole of them from the outer skin. The fibres are next steeped in water for some time, after which they are washed, in order to free them from the matter that still adheres and binds them together. They are now laid out to dry and bleach on rude frames of split bamboo. The process of steeping, washing, and exposing to the sun is repeated for some days, until the fibres are considered properly bleached. Without further preparation they are sent into town for exportation to China. Nearly all the islands near Singapore are more or less planted with pine-apples, which, at a rough estimate, cover an extent of 2000 acres. The enormous quantity of leaves that are annually suffered to putrify on the ground, would supply fibre for a large manufactory of valuable pina cloth. The fibres should be cleaned on the spot. Fortunately the pine-apple planters are not Malays, but industrious and thrifty Bugis, most of whom have families. These men could be readily induced to prepare the fibres. Let any merchant offer an adequate price, and a steady annual supply will soon be obtained.”

The wild brother of the pine-apple has a larger leaf and longer fibre. This is the *Bromelia sylvestris*, or the *B. pinguin* of the West Indies. It is known as *istle*, or *ixtle*, in Mexico, and *pita* and *pinaella* in Central America and Panama. These are probably two distinct species; and there is a third, *B. karatas*, which is hardly to be distinguished from them.

B. karatas is very common in the Antilles, growing in the most arid spots. It makes excellent mats, hammocks, and ropes.

Almost all the fishing tackle of the American mercantile marine is made of it.

The leaves are 5 to 8 feet long, and from $1\frac{1}{2}$ to 3 inches wide, thin, and lined with a fine tough fibre. The plant is self-propagating, and left to itself in an open field will soon cover the ground. In Central America, but particularly in Nicaragua, it is so abundant in the forests as to be a serious obstruction to man or beast. It is largely cultivated in the district of Coatzacoalcas, in Mexico. It is indifferent to soil, climate, and season, while the simplicity of its culture, and the facility of extracting and preparing its products renders it of universal use. From it is fabricated thread and cordage, mats, bagging, and clothing, and the hammocks in which the natives are born, repose, and die. The fibre is sometimes employed for brushes, and in paper-making; its juice is used as caustic for wounds, and its thorns serve the Indians for needles and pins.

The *Bromelias* are widely diffused throughout the tropics, growing everywhere in all varieties of soil. The plant is extensively used for hedges, for which its strong, straight, and spiny leaves admirably adapt it, and may be cultivated with a minimum of labour and cost, and in unlimited quantities. It is closely allied to the pine-apple, but the fruit is different, the ovaries failing to combine in one mass, as in the case of the pine-apple, the formation of which they well illustrate.

The wild pine-apple grows in abundance at Gaboon, Grand Bassam, Assinee, Porto Novo, Liberia, and other parts of the West Coast of Africa. It is employed for making nets, hammocks, superior cordage, and fabrics.

THE PLANTAIN AND BANANA.

Among the splendid, varied, and profuse vegetation, with which tropical countries abound in so infinite a degree, the magnificent, herbaceous plant, the PLANTAIN, usually attracts particular notice; and, together with the coco and other palms, are the productions of the vegetable kingdom, which adorn the picture of the artist when depicting the scenery of the tropics. The broad leaves overhang gracefully the succulent huge stem of the plant; whilst just at their bases, huge clusters of fruit, of yellow, red, and other colours, contrast harmoniously with their shining, dark green foliage.

The height this splendid plant usually attains is 8 feet, but I have seen them reach an elevation of 12 and even 15 feet, with a diameter of stalk from 1 foot to 2 feet.

The plants of the *Musa* tribe, though they cannot, like the palms, be called the princes of the vegetable kingdom, rank first in the series of endogenous plants, and are without exception the grandest of the herbaceous vegetables, whether their gigantic size, the breadth and beauty of their foliage, the abundance and quality of their fruit, or the surpassing grandeur of their flowers, be considered. They are devoid of true stems, but form a spurious

stem, often of considerable thickness, from the leaves as they rise from the root stocks, being sheathing at their base, encircling each other, and enveloping layer within layer the slender flower and fruit stalk. They are not confined to the tropics, but approach in many parts towards the cooler latitudes of either hemisphere. The plantain may be seen laden with its enormous masses of wholesome pleasant food in the mild climate of Madeira; but its yield of fruit is dependent on, and varies with, the temperature of the climate in which it is grown. In this respect it is a striking instance of the increasing bounteousness of nature as we recede from the poles and approach the equator, and is a manifestation of the beneficence of the Creator.

The plantain is universal. It is as the *Penates*—the household god of the labourer's cottage. It grows everywhere on the mountain sides, and might be cultivated to any extent. Hitherto its value has been unknown. Its fruit has been consumed as a substitute for bread, but for all other purposes it has been valueless.

The plantain is, to many thousands of people, what rice is to the Hindoos, rye flour to the Muscovite, and wheaten bread to the Englishman; it is their main dependence (in more senses than one), their staff of life, grown everywhere in small quantities throughout the tropics.

Those who have never lived in tropical countries are unable to fully appreciate its value. Some look even with indifference upon the gigantic clusters of this fruit, as they are unloaded from the steamers and sailing vessels; and yet they deserve special attention and admiration, for they are to the inhabitants of the torrid zone what bread and potatoes are to those of the north temperate zone.

The plantain is one of the most striking illustrations of tropical fertility and exuberance. A plant which, in a northern climate, would require many years to gain strength and size, is there the production of ten or twelve months. The native of the south plants a shoot or sucker, taken from an old tree, in a moist and sandy soil, along some river or lake; it develops with the greatest rapidity, and at the end of ten months the first crop may be gathered, though the cluster and bananas are yet small; but the following year one cluster alone will weigh some sixty or more pounds. Even in the tropics they are always cut down when green, as they lose much of their flavour when left to ripen or soften on the tree.

It is remarkable that the plantain and banana should be indigenous, or at all events cultivated for ages, both in the Old and the New World. Numerous South American travellers describe some one of these plants as being apparently indigenous articles of food among the natives; thus showing (if the plantain be a hybrid) a communication between the tropics of America, Asia, and Africa, long before the time of Columbus. (A hybrid, or mule plant, is obtained by impregnating the stigma of one *species* with the pollen of another *species*, but of the same genus, and what is called a cross-breed is the impregnation of one variety with the pollen of

another variety of the same species.) The older writers on the colony of Guiana, as Hartsinck, Bellin, and others, consider the plantain to be a native. It is worthy of remark that Sir R. Schomburgk, during his travels, found a species of large edible plantain far in the interior. The plantain is said to have been transported from Guinea to the Canary Isles, and from thence to the West Indies. It seems to have migrated with mankind from Asia into the numerous islands in the Southern Pacific Ocean, where it is universal in those which are inhabited, and has degenerated into numerous varieties. It spreads from the Islands of the Pacific and of the Indian Archipelago, northward to China and Japan, and along the Malayan Peninsula to Chittagong. From Chittagong northward, along the jungly base of the Himalayas, there is a suitable climate as far as 30° N., for the *Musa nepalensis* is found in Nepal. The most northern latitudes where the plantain is cultivated are Japan, Madeira, the north of Africa, Syria as far as 34°, and parts of the south of Europe. The edible plantain bears at an elevation of 4590 feet in a temperature of 61° Fahr., and requires 15 months to mature, but its cultivation is little benefit in so high an altitude. It is the same with the cassava root. The cane at 3480 feet altitude gives no sugar, and indigo at 4860 feet affords no colouring matter. We may here remark that it was on these and similar facts that Boussingault based his theory, which is that the time required by a plant to arrive at maturity is as the inverse ratio of the temperature; therefore, knowing the mean temperature of any place, and the number of days which a plant takes to ripen, the time required at any other point, more or less elevated, can be ascertained.

There are 17,000 acres under plantain gardens in the Madras Presidency, chiefly in Tinnivelly.

In Ceylon there are 24,000 acres covered with the banana. The banana is like the plantain, but its stalk is marked with purple spots, and its fruit is shorter and rounder. There are twenty varieties of plantain in Tenasserim, ten in Ceylon, and thirty in Burmah. From Asia it has been introduced into the West Indies and South America, and into England in 1680. It is more productive than wheat. In South America the fruit is dried and preserved, while the flour is separated and made into biscuits. The fruit can be kept for twenty or thirty years owing to the sugar in it; 100 parts of the fresh fruit contains 27 of dry nutritive matter; the potato gives 25. In the plantain fruit out of 100 parts there are of—

Water	14 parts.	Sugar	2 parts.
Starch	67½ "	Oil	½ "
Gum	4½ "	Albumen	4½ "
Cellular fibre..	4¾ "	Ash	4½ "

A sucker attains maturity in a year; each produces a bunch of fruit weighing from 25 to 90 lbs. One tree gives 4 lbs. of fibre; 600 lbs. weight of fibre might be produced annually from each acre of plantains. The plantain is used as a nurse or shade to the

betel vine and other plants. The top of the stem yields a juice good for making ink. The fibre can furnish material for paper and canvas; thus the plantain gives food for body and mind. The Chinese use the young shoots for paper-making; 1607 square feet of ground yield 4000 lbs. of nutritive substance from plantains, which will support fifty persons; the same space planted with wheat will support only two.

It is in season all the year round. The Dacca plantain is 9 inches long; in Madagascar the plantains are as large as a man's forearm. In the mountains of the Philippines a single fruit or two is said to be a load for a man. All the large ones require, like potatoes, to be roasted.

Twelve months after planting 70 lbs. of fruit are often obtained from a single plant. The south of Spain is the only part of Europe in which the banana is cultivated in the open air.*

The name of plantain and banana is very indiscriminately applied in many countries where they are grown, but, properly speaking, the term plantain is restricted to the larger plants, the fruits of which are usually eaten cooked, while those of the banana, when ripe, being more saccharine, can be eaten raw as fruit. The French call the plantain "banane," and the bananas "bacoves," or fig bananas. Generally the pulp contains no seeds, but in Akyab and the Arracan coast there exists a species which is full of seed. These are large, black, and not unlike the cotton seed. The flavour, also, is very inferior. The Poyat, or Martinique banana, grows to a very large size in some districts, and would possibly yield more fibre than the common plantain.

Trinidad.—In former years, $7\frac{1}{2}$ million plantains were annually imported from the Spanish Main to supply the local consumption in this island, 9 millions being required in Port of Spain alone. Although the foreign imports are now less, yet the increased extension of the cultivation is recommended.

The establishment of plantain walks for the annual production of 9 or 10 million fruit will necessarily be a work of time, as plants for any great number of stools require time and outlay to collect and carry. A thousand plantain suckers take some gathering, and are not as easily carried as tobacco seed, of which one can put as much as will sow several acres in an envelope. It must take years to establish any extensive plantain cultivation. A bunch of plantains of the kind commonest here and on the Main (usually called horse plantain) does not consist of more than 20 to 25 fruit, and as it might not be safe to reckon on more than three bunches fit to gather from the stool in a year (generally stated at four during the twelve months), one cannot reckon on an acre, with the stools planted at 10 feet apart, producing more than 30,000 to 40,000 plantains per annum, as at such distance the acre will hold but 430 or 440 stools.

It will be seen that it would not require more than 220 acres to yield the 7 million plantains wanted, nor more than 310 acres,

* Long's 'Plants of Bengal.'

in full yield, to give the 10 millions that could be disposed of for ordinary consumption. We say *ordinary* consumption, because there are other applications of the plantain, by which it could be converted into an article of commerce commanding a sale abroad, the amount of which is entirely uncertain, but might easily exceed the local demand for the raw article if it fell in with the popular taste in northern countries. These applications have not yet been tested, so far as we are aware, on a commercial scale, but they undoubtedly open a great possible future for what old Dampier called "the King of Fruit."

With regard to its geographical distributions, the plantain is an object of cultivation over an immense zone, which extends, although not continuously, from 38° N. to almost 35° S. latitude. A mean temperature of from 18° to 20° Cent. suits it best, provided, however, the winters are not too rigorous. In Cuba the small species are cultivated in situations where the thermometer falls to 7° Cent., and even sometimes almost to zero. The *Musa sapientum* is satisfied with 18° of mean heat, but *Musa paradisiaca* requires at least 20° to 22°, and that, too, only in the climates of equatorial regions. It produces the best crops in a temperature of 24° to 28°, and yields no fruit at 20°, nor at an altitude of more than 3000 feet in the southern latitudes from 0 to 10° (Humboldt).

In the Cordilleras of New Granada the banana is productive at an altitude of nearly 6000 feet, but according to Boussingault, the fruit never ripens at an elevation of 7000 feet. Schomburgk has seen the *Musa* bearing fruit in British Guiana at 3000 feet above the level of the sea; the fruit was magnificent, and would have borne comparison with the finest from Porto Rico. In Hindostan the *Musa* is cultivated at an elevation of 3700 to 5000 feet, at Kumaon and Gurhwal, in the middle of the Himalaya chain. Major Munro found a wild species at Kondah (Nilgherries), nearly 7000 feet above the level of the sea. Dr. Madden also discovered an indigenous *Musa* in the Himalaya range, to the north of the province of Assam.

Asia is, as we have seen, the native country of the banana plant; many varieties are also found in the Indian Archipelago, China, Cochin China, and Hindostan. On one side of the continent they are spread over Polynesia, and, lately, in Australia; and on the other, in Persia, in Beloochistan, in Asia Minor, as far as Mount Taurus, and in Arabia. In Africa the banana has not the same importance as in Asia and America, except sometimes in Guinea and Madagascar, where many indigenous *Musas* are cultivated. It is not to be found on the eastern coast, but only in gardens higher up the country, in Abyssinia, Nubia, and Egypt. The northern part of Africa also possesses the plant, which has been carried thither by the victorious Arabs, but no great attention has ever been paid to it in that region. When we pass into Europe, we see the banana appear in some gardens in Greece, in Sicily, and especially in the southern provinces of Spain. It was introduced into the last-named country by the Moors, who cultivated it extensively in the neighbourhood of Armenia. The eastern parts

of Portugal, whose marine and equal climate is singularly favourable to the naturalisation of tropical plants, include even the *Musa sapientum* among their garden productions. The *Musa Cavendishii* and *Musa sinensis* have also been successfully introduced into that country. Equatorial America has immense resources in the banana; Mexico, Central America, Colombia, Upper and Lower Peru, Brazil, the Guianas, and the Antilles, more especially Haiti and Cuba, cultivate this plant on a vast scale. The banana exists even in Louisiana, Florida, and the other Southern States, where efforts have been made for some time to extend its cultivation.

A warm and rather moist soil is best suited to the propagation of the banana, that is to say, a soil in which there is a plentiful admixture of clay, as in the immense valleys of America and Asia, and in the grassy plains of Malaysia. It seems to like the neighbourhood of the sea, and an atmosphere impregnated with salt, for it is in that kind of situation that it appears to prosper best. In Egypt it grows well in the nitrous plains of Rosetta. In the majority of countries where the plantain is grown no manure is necessary, owing to the decomposition of the stems and the alluvial nature of the soil. But in other less favourable soils manure may be requisite to maintain a vigorous and constant production. A plantain walk is usually established a little before the rainy season commences. The soil is loosened to a foot or less, so as to receive the young plants. It is thoroughly cleansed of all weeds and stones which may be there. Then shoots or suckers are taken from the parent stem, of from 2 to 3 feet high, their bulbs being divided from the principal bulb by means of a mattock. These slips are cut about 8 inches above the neck, and placed in a slanting direction in the prepared holes, and covered with earth, leaving in sight only about 2 inches. The length of time which elapses between the planting of the slips and their fruiting depends on climate, situation, and variety of species. Thus *Musa sapientum* fruits in the fifth and sixth month, whilst the *Musa paradisiaca* requires ten months, and sometimes even a longer time than that. Two varieties of the fig banana, the *canaya* and *gengi*, produce their fruit in five months. In mountain districts, the fruit of the large banana ripens only at the end of eighteen or twenty months of cultivation; some varieties indeed, in such position, take three years to produce fruit. The leaves of the banana afford a useful shelter, and it is therefore of great service in tropical agriculture to young plants, which would otherwise suffer severely from the excessive heat of the sun.

In British Guiana, the plantains are set six yards apart, and yams, maize, cocos, or canes planted in the intervals.

The cultivation of the plantain is one of the easiest to undertake, and at the same time one of the most profitable; when once it has been planted, there is nothing more to do except realize the harvest, for the trifle of manure bestowed upon the soil two or three times a year is nothing in comparison with the labour necessary in Europe to bring crops to perfection. As these plants renew themselves with offshoots at different degrees of develop-

ment, it follows that each plantation offers at the same time rows whose branches are laden with ripe fruit; rows whose branches are full of blossom, and young offsets, which give promise of future plenty. In the best situation, three rows are counted to each cluster of bananas, sometimes four; in general they obtain five rows in two years. "There is no culture that can be undertaken with more confidence than that of the banana," says M. Boussingault, "for if climatic influences should sometimes have a prejudicial effect on the crop, they could never completely destroy the prospect of a harvest, as the certainty would always remain of that to be obtained from the surviving and stronger growing offshoots or suckers. No other vegetable production presents similar advantages—not even the maize, that crop so precious in the warmer regions of the globe.

"The enormous return from this plant assures to the inhabitants of tropical countries an abundant means of sustenance, and one that can be obtained at a low price, as it is acquired without difficulty. But in consequence of the facility with which, thanks to the banana, the means of sustenance can be obtained, as the proverb runs, '*Personne ne meurt de besoin en Amérique*,' the inhabitants have a great excuse for being indolent, which they are already inclined to be on account of the climate."

The large banana is gathered at three different stages. At a fourth part of its maturity, it is rather milky and contains much starch. If it is roasted in ashes, or boiled in water, it forms a very nourishing food, capable of being substituted for bread. If cut at three-fourths of its growth, it is less nourishing, but contains more sugar; in this state, it is eaten as an accompaniment to meat. Lastly, when the fruit is perfectly ripe, all the starch is changed into gum or sugar; it then develops an acid principle; in this state it is eaten either raw or in the form of fritters. The banana fig, which is eaten when perfectly ripe, is rather a fruit than a nutritive substance; it is soft, full of sugar, melting, possesses a powerful perfume, and forms a principal dish for dessert in tropical regions. In some countries they cut them while they are green, and hang the bunches in their houses to ripen. To hasten their ripening in China they are covered with rice, or even with lime. The Chinese also eat the flowers of the banana pickled with vinegar.

The banana when plucked keeps fresh for a week; at the end of that time it becomes yellowish and more sugary; in twelve or fifteen days it begins to decompose and ferment. In America there are two methods of preserving the banana; the first, used when the fruit is green, produces banana farina; the other, when the fruit is completely ripe, produces the *platano-pasado* of the Mexicans, or the *platano-curado* of the province of Neyba, New Granada.

There is a method of utilizing this plant, made use of in South America, but it is defective in a great many points as compared with that already noticed. They grate the fruits, having first peeled them, squeeze the moisture out in a press, bake them, like

manioc, in an oven, and by this means obtain a coarse kind of flour. But the nutritive property of this is inferior to that prepared from the dried slices, for no doubt the pressure which extracts the moisture expels also the soluble albumen, and other nutritious qualities.

The next method of preserving the banana very closely resembles that commonly used in the preparation of dried fruits, such as figs, prunes, &c. The time chosen is when the fruit is quite ripe, and its skin has become of a yellow colour, shaded with black. In Mexico in the "terras culientes," and particularly in Méchoucan and Xarisco, bananas are dried simply by exposure to the atmosphere. According to Colonel Colquhoun, they proceed in this manner: the fruits are exposed to the sun in bundles, and when they begin to wrinkle they are peeled, for the skin, if left on, causes a disagreeable flavour. They are kept for some time, until an efflorescence of sugar appears on their surface, as on dried figs and prunes. They are then pressed in masses of about 25 lbs. each, and wrapped in leaves of the banana plant, or else kept in boxes. Of course, these methods can only be adopted in countries where the climate is very dry. In others, recourse must be had to artificial means, which are unfortunately more costly.

There are three distinct ways in which the ripe banana may be dried. First, exposing the fruit to an atmosphere of sulphuric acid gas before the desiccation is begun. Second, boiling rapidly very ripe fruit in water which contains sulphate of lime. Third, by boiling it in syrup. By either of these, the albumen and caseine of the fruit coagulates, and the tendency of the banana to decay and ferment is stopped at a period favourable for desiccation. Experience shows that the second method is the best to employ; in moist climates, without this precaution, the fruit, instead of drying, becomes damp. To expose the fruit to the sun's rays after boiling, trays of bamboo, as in Mexico, or of anything which permits the free action of the air and light on the fruit, may be used. If rain falls, they are dried in a furnace, which must be left open, otherwise the bananas bake instead of drying. The heat, also, must be moderate. The bananas, when dry, are pressed and packed in boxes. The fruit thus prepared is a very good article of food, resembling figs, and its abundance and easy preparation would render it a cheap one.

Some of the fruit of the plantain was exhibited at the Great Exhibition of 1851, that had been in England for sixteen years. It was still in an eatable state, and had much the taste of dried figs. The cost of keeping up a plantain estate in Demerara would be about £6 per acre; and the produce of the stem alone for fibre, if cut every eight months, would be 1400 or 1500 good stems every cutting, or 4500 stems in two years. The average quantity of fibre per stem may be put at 4 lbs., or 9000 lbs. per annum per acre, at a cost of £6; and add £4 for the preparation for market, the cost would not exceed $\frac{1}{2}$ d. per lb. In this way (by the succession of suckers) the production of the plantain is enormous; and Humboldt's statement, once thought exaggerated, that an acre of

good land in the tropics, covered with the plantain, would yield as much nutritious food as 144 acres of wheat, is no longer denied or doubted.

The plantain is noted for the abundance and excellence of the nutritive food which it yields. The fruit is served up both raw and stewed; slices fried are also considered a delicacy. Plantains are sometimes boiled and eaten with salt meat, and pounded and made into puddings, and used in various other ways. In their ripe state these fruits contain much starchy matter.

A few bananas are occasionally imported to England, but they are seldom received in such perfection as to form an estimate of their flavour; nor are they at the best of times much appreciated. A considerable trade is, however, carried on in bananas between New York and Aspinwall, the Atlantic seaport of the Panama railway. Not a steamer leaves without taking from 5000 to 8000 bunches, and during the year something like 200,000 bunches (or 800 tons) of bananas are exported to New York. They are grown in plantations or walks, seven or eight miles from the town. After the small bush is cut down, fire is run over the land, and the suckers are planted irregularly all through, 6 or 7 feet apart. The kinds principally cultivated are the doubloon, the China, and the fig. The last most resembles the honey banana of Jamaica. The plantain is not exported, but is only used for home consumption. The Indians manufacture a kind of spirit from the plantain. When the fruit is fully ripe, the Indian gathers it, peels off the skin and throws the fruit into a dish, where it remains for some days. After fermenting, he draws off the liquor and puts it in his home-made bottle for future use. The liquor, or as the Indian terms it, "rum," is said to be strong and very intoxicating. When drunk to excess the effects remain for two or three days.

In Jamaica, the banana seldom comes to maturity in less than twelve or fourteen months; but in Aspinwall, six or eight months are sufficient. In Jamaica, when a sucker is planted, it only comes up single and bears but one bunch of fruit; but in Aspinwall a sucker comes up with several shoots, and these bear in succession one after another. The bunch of fruit is cut with as long a stalk as possible, for the convenience of carrying, and it is always cut green before it ever begins to ripen, or the fruit would rot before they arrived at New York.

The banana is the chief fruit at present cultivated in the West Indies, and this fruit is the one which in the future will be more largely offered in the English market than any other. There are numerous varieties of this fruit under cultivation. The Martinique banana is found the most profitable to grow for export, although a smaller fruit, known as the fig banana, is more luscious and more highly esteemed locally as a dessert fruit. Jamaica exports bananas to the value of nearly £200,000 per annum, and is capable of growing fully three times the quantity now exported without any diminution in the larger staples. The fruit when cooked furnishes an important article of food to the negroes in the West Indies.

Plantain Meal.—A meal is prepared by slicing the plantain and

drying it in the sun, after which it is ground. It is very palatable and digestive, and suitable for invalids or children. The composition and nutritive value of this meal closely approaches to rice. One acre on an average would yield upwards of one ton of meal.

This flour of the plantain, known in many parts of the West Indies as *conquintay*, is highly esteemed, and extensively used as a food for invalids and children. It is decidedly superior in these respects to arrowroot, in consequence of its nourishing and strengthening qualities. But it is scarcely known at all in Europe, where I believe it would be greatly prized. It is prepared by stripping off the husk of the plantain, slicing the core, and drying it in the sun. When thoroughly dry it is powdered and sifted. It has a fragrant odour, acquired in drying, somewhat resembling fresh hay or tea. It is largely employed as the food of infants and invalids. As food for children and convalescents it would, probably, be much esteemed in Europe; and it deserves a trial on account of its fragrance, and its being exceedingly easy of digestion. In respect of nutritiveness it should have a preference over all the pure starches on account of the proteine compounds it contains. The plantain meal would, probably, be best and freshest were the sliced and dried plantain cores exported, leaving the grinding and sifting to be done in Europe. The flavour of the meal depends a good deal on the rapidity with which the slices are dried; hence the operation is only fitted for dry weather, unless, indeed, when there was occasion for it, recourse were had to a kiln or stove.

Plantain starch cannot enter into commercial competition with other starches. The difficulty of separating it from the rest of the constituents of the fruit, its unusual colour, and the high value of the fruit in its other applications, will, probably, prevent its being considered but as a curiosity. The colour resists the free application of chlorine water. A few particles of the starch under the microscope show irregularly oval corpuscles, and some oblong, varying from $\frac{1}{475}$ to $\frac{1}{950}$ of an inch in diameter, and, in most cases, $\frac{1}{425}$ of an inch in breadth. A few globules, almost spherical, are observed, measuring $\frac{1}{3800}$ of an inch. As the colour, however, is sufficient to identify this starch, no aid from measurements or shape of its globules is required.

Vinegar from the plantain is obtained by a very simple process. When there is a temporary glut in the market, the surplus, when yellow, is thrown into baskets, supported on open barrels. The fruit liquefies and drops into the receiver, where the juice ferments and speedily becomes vinegar. No water is used in the process.

Let us now glance at some of the uses of the stalk. The stem is filled with an abundant pith, enveloped in fibrous cases, and containing much starch. This boiled might serve as human food; animals like it very much. Cattle, and especially the pig, relish this kind of sustenance.

A curious fact connected with the banana plant is that the sap is so abundant that it escapes whenever an incision is made into the outer coating. The sap has been examined and analysed by

Fourcroy, Vauquelin, and Boussingault. According to the last writer it contains tannin, gallic acid, acetic acid, chloride of sodium, salts of lime, potass, and aluminium. If cotton, linen, or flax are dipped into it whilst perfectly fresh, it deposits a colouring matter of a yellowish grey, which adheres to the fibre. When exposed to the air it becomes agitated, and precipitates floccules of a dirty rose colour. This phenomenon is produced by the oxygen contained in the atmosphere. The banana plant is used in Annam, or Cochin China, and the Philippines, in the process of refining sugar. Masses of raw sugar are placed in layers 1 inch thick and 10 wide, which are covered by a layer of stalk of this plant, cut into small pieces. According to Grosie, however, it is the ashes of the *Musa paradisiaca* which they use in this process. The aqueous liquor that flows from the stalks filtrates through the sugar, carrying away with it all impurities, and leaving the sugar in a crystallized state. The sap is also of great value as a mordant in dyeing; the Malays, by means of it, fix the green colour of the *Dolichos Lablab*. When employed alone the sap of the cochon banana communicates to fabrics a purple tint, which is durable. The sap has also medicinal properties. It is used in St. Domingo to stop internal and external hæmorrhage, as tannin is in other countries; and at the Philippines, to heal a species of venereal disease very common in the province of Bisayas.

In Cuba, Mr. Russell tells us, "The plantain, or banana, is seen growing over the whole island, affording shade and shelter to every cabin, however small or mean. Though it wants the grace and beauty of the coconut palm, its form is peculiarly tropical, none more so. In good soil it grows to the height of 20 feet. It is about 9 inches in diameter at the base, tapering towards the top, when it sends out long broad leaves, and also a short stalk bearing a heavy cluster of fruit (which, in Jamaica, I have known to weigh as much as 70 lbs.). The plantain requires to be renewed on good soil only once in forty years. Little care is bestowed upon its culture, being planted in check rows 12 feet apart. The ground usually receives two ploughings during the season. It is not unfrequently seen growing, however, on the shallow soils of the coral formation, where there is little for it to fix its roots, except the crevices of the rock. It is largely used by all classes, and commonly pulled when green, and cooked with grease or oil. In Jamaica it is roasted in the wood ashes of the kitchen fire, and used as a substitute for bread, and it is also boiled and used as a potato. In this form it is seen on the tables of both rich and poor. For, although the plantain cannot support the strength of the overworked labourer, it furnishes, when the work is light, a most wholesome and delicious food. . . . I rode through a field of plantains attached to an estate, of 60 acres in extent."

The plantain, or banana, is generally admitted to be a better developed plant in the West than in the East Indies. All hot climates seem equally congenial to its growth. It is considered by the best authorities to be a native of the East Indies and other parts of the Asiatic continent, and probably of Africa. Baron

Humboldt has, however, suggested that several of the species of *Musa* may, possibly, be confounded under the names of plantain and banana, and that some of these may be indigenous to America. Linnaeus conjectured that the Bihai (*Heliconia humilis*), a native of Caraccas, which produces fertile seeds, is the stock of the plantain.

Dr. Royle, whose opinion is more reliable on the subject, agrees with Mr. Brown in thinking "nothing has been advanced to prevent all the cultivated varieties being derived from one species, *Musa sapientum* (also called *Musa paradisiaca*, the banana), of which the original is the wild *Musa* described by Dr. Roxburgh as grown from seed received from Chittagong."

The banana and plantain form a large portion of the food of the natives in New Caledonia. Before the French occupation they had but four species—*M. fehi*, Bert; *M. paradisiaca*, Linn.; *M. discolor*, Hort; and *M. oleracea*, Nob. *Musa sinensis* and *sapientum*, introduced only a few years, have begun to be extensively cultivated among the tribes.

The plantain loves moist situations, and requires, for perfect development, a rich soil. The labourers plant it much too closely; it should be allowed, from root to root, a space of 14 feet good. The first year's crop thereby may be reduced, but the cultivator will have his reward in the subsequent yield. Besides, in wide planting, the better opportunity is afforded of self-reimbursement to the planter in the shape of inter-culture of other minor articles, such as Indian corn, peas, &c.

Plantain Fibre.—When the fruit has arrived at maturity, the stem that bore it is felled and left to rot on the ground, but this might be turned to advantage for its fibre. It is stated officially that the yield of fibre from thousands of acres of the plantain is lost annually in the colony of British Guiana alone, for want of simple and inexpensive means for separating it. Could an efficient and cheap machine be invented, the fibre would be almost entire profit to the planter. The banana yields less fibre than the plantain, and it is generally somewhat discoloured or tinted.

The next point for consideration is the machinery necessary for cleaning and preparing the fibre; it is recommended that the stalk be cut into lengths of about 4 feet, and also divided into four, so as to be able to separate the different qualities of fibre before passing through the mill, formed of horizontal rollers, by which means the water and a portion of feculæ or pulp would be pressed out. There would still remain a portion closely adhering to the fibre to be got rid of, which would require a scraping operation, which there is no doubt could be performed by means of a scraper of wood or metal attached to the mill, and put in motion by the same motive power; it would then require the application of water, the more effectually to loosen the remaining matter; exposure to the sun would dry and bleach it after being passed through a heckle, which would separate the threads. The difference in value of each description and quality of fibre must depend upon its strength and its fitness for the various purposes for which it would be found applicable in the manufacture of cloth, cordage, paper, &c. Prac-

tical experience would soon prove the most effectual methods of performing the several operations, and if fitted to the purposes for which they are required; the most suitable localities for these plantations would, no doubt, be in the mountain districts, or in the plains, if well supplied with streams of water running through them. Experience will soon determine which variety of *Musa* is most valuable for producing fibre for manufacturing purposes. The best plant for this purpose is that which will produce the greatest return in the shortest period, requiring but little knowledge and expense in cultivation.

The one pre-eminently fitted to answer all these requirements is the Martinique banana (*Musa sapientum*), requiring but little or no skill and energy in its general management; for quantity, colour, and texture of fibre, it surpasses by far all varieties of the common plantain (*Musa paradisiaca*), which is a delicate plant, and frequently requires to be renewed or re-planted. The production of suckers and weight of stem are at least one-third less than the banana, and the fibre by no means so strong. I would also recommend two other species of *Musa* to the cultivators of this genus for their valuable fibre. One is the *Musa violacea*, an exotic from the Philippines, and in no respect inferior to the banana, except in the absence of edible fruit. The plant is exceedingly prolific and hardy. The other is the one producing the well-known Manila hemp (*Musa textilis*), and no expense or trouble ought to be spared by the Colonial Governments to introduce suckers and seeds of this most valuable plant in quantity in the West Indies, as it takes a long time to obtain stock from the produce of one plant.

The following is the mode of preparing plantain fibre in Jamaica:—

The plantain is cut when ripe, and the outside layer is split in longitudinal slices and put through a mill, and afterwards boiled in a copper, with a small quantity of potash, soda, or quick-lime, to take off the mucilage. This layer is the *coarsest*, and requires a longer time to boil, therefore is to be done separately. The next layer is to be done the same way, and being finer and more valuable, should be kept by itself. The following layer ditto. The centre part of the plantain ditto.

As the inner part is the finest fibre, requires the shortest time to boil, and commands the highest price, that is the reason why these boilings require to be performed separately.

After boiling, the fibre is hung up on ropes to dry, and it can then be carried down and sold to the merchants, or shipped direct.

Several modes have been recommended for the preparation of the fibre.

1st. Beating, washing, and drying.

2nd. Simply cutting and drying.

3rd. Scraping.

If we look at the structure of the plant itself, we shall be able to form an estimate of those processes.

The plant is composed of at least two very visible rows of cells, an inner and outer, along its whole extent upwards and downwards, and through every layer, there being several layers.

The cells are formed of fibre, for "uprights" and "sills" and "plates," and tissue, as it were for "plastering;" the former useful for ropes, fabrics, &c., the latter for paper.

Of the processes named above, the last is the only one that produces fibre in its pure state; but, whether we scrape from the inner or outer surface, we must lose all the tissue, and probably more than half the fibre.

The first process will produce the material of the plantain stalk in a fit state for shipment with partially clean fibre, but nearly all the tissue will be lost. The washing, also, should be simple rinsing, for allowing the tissue to remain in water tends to discolour it greatly.

The second process, I imagine, would be very slow, in consequence of the abundant water of the stalks. I apprehend also the discolouration which would ensue from the process would render the material all but unfit for market, except at a very low rate.

It seems desirable that three or four objects should be kept in view in any process:—

1st. Saving of the cellular tissue for paper.

2nd. Preserving the fibre of an agreeable appearance.

3rd. Ultimate freeing the fibre from the tissue.

4th. Preserving all the fibre.

And, with relation to these, the processes and mechanical arrangement are to be considered.

By no process of the hand can clean fibre be profitably secured. For this resort must be had to machinery.

The fibrous material, that is to say, the stalk after it has undergone the squeezing process without separation of the tissue or pulp, may be prepared either by hand or machine, the latter being, of course, the most economical.

Squeezing, rinsing, partial separation, or "teazing" with the hand, after being hung up on rails of bamboo, or other cheap article, and rapid drying, may be recommended as a simple and efficacious process for obtaining the fibrous material in a favourable state, and with the several objects referred to in view.

Machinery for performing this, and effecting the final separation of the fibre from the pulp or tissue, must be a desideratum. In the absence of such machinery, parties can only hope to prepare advantageously the fibrous material by hand.

It has been supposed that boiling of the material would render the separation of the fibre at a future time more easy; but this seems unnecessary. Simple saturation in water for some few hours renders it fit for further process.

Much objection is felt by the labourers, from whom alone are the stalks at present to be procured in abundance, to cutting the stalks, from the fear of injury to young shoots by loss of manure. It would be well if fear on this head could be shown groundless.

The Rev. W. J. Pearson, of St. Thomas's, Jamaica, thus speaks, after much practical experience in the preparation of the fibre:—

Provided the tissue remain on till it reaches England, the fibrous material ought to be more valuable than the clean fibre, for the worth of the pulp should exceed the cost of separation. In the preparation of the material, also, it seems unnecessary to preserve more than two qualities, that of outer and inner, and this not from any great difference in the fibres, but from the colour of the tissue, the outer being darker than the inner. Coarse and fine fibres will be found in every layer, and the former are, for the most part, but assemblages of the latter.

In trying the strength of the fibrous material, it will be well to ascertain *whether you have a thin or stout fibre* overlaid with tissue, otherwise the result would be deceptive.

The process of preparation, both of the material and of the fibre, being tedious, it is very probable that difficulty will be experienced in inducing the labourers to engage in it on their own account, at any rate until the returns become certain and profitable.

The quantity of material or fibre yielded by a sucker is, at present, so small that until results prove remunerative, they will not have sufficient inducement to enter on the new source of industry. From my experience, stalks do not average more than $1\frac{1}{2}$ lb. of fibrous material, consequently of clean fibre much less. The fibrous material seems almost fit for the manufacture of small cordage, even as it is.

It must not be supposed that the work of preparing the "material" is either easy or pleasant. To bring up the suckers from the deep valleys in which they sometimes grow, is a difficult task, and to carry them on the head up hill and down dale, as has often to be done, is very laborious. While some suckers are small, there are others frequently heavier than can be borne by one man, and until the work can be carried on by cart, there is no help but to divide such for long distances. The process by hand of expressing the watery parts is also very tedious, and drying and baling require much care and attention.

Manila hemp takes its name from the chief city of the Philippines. It is not hemp, however, but the fibre of a species of plantain (*M. textilis*), which does not differ greatly from the edible banana, and is probably a variety of the same species. Thus far, according to Dr. Jagor, the serviceable fibre has been exclusively obtained from the southern portion of the Philippines, all attempts to make its cultivation profitable in the western and northern provinces having failed. A species of banana grows in great luxuriance in Western Java, but it has not been utilized as a fibre plant to any great extent. Great efforts were made in Celebes to cultivate this fibre, but it has been abandoned in favour of coffee, which is found to be far more profitable. For domestic purposes the plantain fibre, known to commerce also as abaca, is made use of in many tropical countries, and in time will doubtless be largely supplied; but for the present the supply comes, as already stated, from the Philippines.

There is some dispute as to the true scientific name of the species of *Musa* from which the Manila hemp of commerce, the *abaca* of the Portuguese and Spaniards, is obtained. It is now usually assigned to *M. textilis*, Nees, but probably some may be obtained from *M. Troglodytarum*, Lin., a native of the same locality. Some ascribe it also to *M. sylvestris* and *M. Balbisiana*. There are several species of *Musa* wild and indigenous to the Amboyna, Moluccas, and the Philippines.

The plant thrives best on the shaded forest-covered slopes of volcanic mountains, such as abound in Albay and Camarines; on level ground not so well, and on marshy land not at all. The plant requires, on an average, three years to produce its fibre in a proper condition. For the first crop only one stalk is cut from each bunch; later on, the new suckers grow so quickly that they can be cut every two months. In full growth the yield is 30 cwts. to the acre, whereas from an acre of flax not more than 4 cwts. is obtained. After the plantation is once established, the plants flourish without any care or attention, the only trouble being to collect the fibre. One plant may yield as much as 2 lbs. of fibre, but the average is not more than 1 lb.; on indifferent soil much less.

Several grades of fibre are derived from different parts of the stem, the edges yielding the finest. The fibre, which lies next the surface, is stripped off by hand in broad bands, and then softened by being drawn backwards and forwards between a broad-bladed knife and a block of wood. The fabrics woven are nearly as fine as the *nipis de pina* (pine-apple fibre). For purity, flexibility, and colour, the finest of these plantain fabrics are said to compare with cambric as cardboard does to tissue paper. According to Jagor, the finest stuffs require so great an amount of dexterity, patience, and time in their preparation, and are consequently so expensive, that they cannot compete with the cheap machine-made goods of Europe. Their fine warm yellowish colour also is objected to by European women accustomed to linen and muslin strongly blued in the washing. By the rich half-castes, however, who understand the real goodness of their qualities, they are highly appreciated. In the regions where abaca is cultivated, the entire dress of both sexes is made of this coarse cloth, called guimara. For foreign markets, still coarser and stronger fabrics are prepared, such as crinoline and stiff muslin, used by dressmakers.

It is as an article for export, however, that the cleaned fibre is of the most importance commercially. Nearly half of the produce goes to America. Much of the refuse is very largely used in the manufacture of paper.

From the fibre of this plant, cordage, mats, and wearing apparel are made in the Philippines.

Leyte and Saniar in 1856 had a combined export of 5000 tons; Negros, 800 tons. South Camarines and Albay produce the largest part of the existing export of fibre, and yield a considerable quantity of remarkably good quality.

Large supplies are derived from Leyte, Saniar, Bohol, and the

east coast of Negros (Dumaguete), in its more immediate vicinity. While from the great island of Mindanao a further supply is obtained, from the fine province of Misamis, and from the small island of Carnaguin, which produces nearly 1000 tons of good hemp, all of which goes to Cebu.

The plantain from which it is obtained is propagated with great rapidity, being planted in the rainy season. One hundred plants occupy about 1000 square yards of land. The rude method of preparing the fibre is as follows: The stem, after having attained the age of between two and three years, is cut down and stripped of its layers or folds; these are then divided into sections of 3 or 4 inches wide, and the pulpy or fleshy part separated by the process of drawing them under a knife fixed for the purpose; the fibre thus laid bare is then placed in the sun to dry. If the plant be left on the ground for any length of time after it has been cut down, the hemp made from it assumes a reddish tinge, unfitted for commerce, the tannin in the sap colouring the fibre. Fifty tons produce about 25 lbs. of hemp or fibre.

The difference that exists between the fibres of the species of plantain appears to be attributable to the fact that some fibres of wild plants, and especially those of the banana, are more or less modified by cultivation. The abaca is found in the volcanic islands of the Philippines, and in the neighbouring archipelago; still, it is principally in the pueblos of Donsol, Sorsogon, Tabaco, Cameli, and Quipa, that the cultivation is carried on, and from whence the best material is obtained. The only difference between the abaca and other species of the *Musa* genus is the rich dark-green hue that pervades every part of the former. The abaca has very little care bestowed on its cultivation, being grown only for its stalks, and it is an advantage rather than otherwise that its fibres should retain their natural coarseness and tenacity. Nor does it require so rich a soil as the edible varieties: it is usually planted on the slopes of mountains, where the land has been newly broken up. The ground is carefully and frequently cleared of all obnoxious weeds during the growth of the young plant, and the stalk is cut when the fruits first make their appearance. At the end of the first crop they have, monthly, good suckers springing up, and that, too, during the whole time that the plantation lasts, which is from five to seven years. The duration, of course, varies with the nature of the soil, the fertilizing properties of which this crop exhausts very rapidly, especially as no manure is applied. The textile material is obtained in the following manner: The stems are cut down and stripped of their leaves. It is next divided into long strips of two fingers in breadth, then passed between a thick plank, placed in a horizontal position, with a knife resting edgewise. The material is then drawn through with one hand, whilst the other presses heavily on the back of the knife, and in this manner the pulpy matter is scraped and cleared off, leaving the textile fibres bare. These are put to dry in the sun, care being taken to protect them from rain and moisture. They are then beaten lightly with sticks, again exposed to the sun, and lastly

the filaments are separated according to their degrees of fineness. In this manner three sorts of fibre, of varying quality, are obtained: the first, called *bandala*, from the outer sheaths of the stem, which is the strongest and coarsest, and from which ropes, &c., are made; the second, known by the name of *lupis*, which is the finest, is procured from the inner layers; whilst the third, the *tupoz*, comes from the intermediate layers of the tissue, and from this last fabrics and gauzes are manufactured. Two men employed at this work, one in separating the outer coats, the other using the knife, can prepare from 24 lbs. to 26 lbs. avoirdupois a day. Fifty feet of land covered with plantain trees will furnish from 24 lbs. to 26 lbs. of abaca fibre, or 143 lbs. to 145 lbs. to every $2\frac{1}{2}$ acres. It is cut at least ten times a year, which gives a mean return of 1760 lbs. of bruised abaca, worth from £5 to £10. If the process be properly conducted, at least 1 lb. of thread, or, taking the produce of $2\frac{1}{4}$ acres for a whole year, 3520 lbs. of abaca will be obtained, worth at Manila about £20. The abaca intended for weaving is bruised in a mortar, and thus reduced into a kind of ball about the size of a child's head. This operation has the effect of rendering the threads more flexible and resistant. These threads, having been joined together by women or children, are woven after the manner of cotton, and the texture is immersed in water with a little shell lime for a day and a night. Afterwards they are cleaned in fresh water and left to dry. If mixed with silk or cotton, a beautiful texture is produced, very fine and valuable, and applicable to a variety of purposes.

Roping and cordage made from abaca are employed in the mercantile marine of India, and in the navy of the United States, and are well known under the name of white rope or Manila rope.

Machines have been invented to remove the fibre from the pulp, but few are used. One was exhibited at Manila about three years ago, very simple in its construction and apparently producing results vastly superior to the ordinary mode I have described of manual labour. The exhibition of this machine produced a great excitement, and it was proposed and countenanced by the Captain-General to give a large premium to the inventor. The subject died away, however, and the machine disappeared from public view. It is probable that the criticisms of experienced people formed some drawbacks to the perfection generally ascribed to the invention; but, without possessing the slightest mechanical knowledge, the impression which its structure and effect made on persons capable of judging was extremely favourable. There was no intricacy in its machinery; wood was its only material, and a buffalo its moving power; a village carpenter could make one from a model, and its results were tenfold or more greater than by the ordinary course. I cannot affirm that the model has not been applied; but there are circumstances or influences in regard to the natives here and the culture of this production, and, indeed, of all others, unfavourable to the extensive adoption of machinery.

EXPORTS OF MANILA HEMP from the PHILIPPINES.

			Piculs.				Piculs.
1850	..	..	124,367		1874	..	616,122
1872	..	..	613,240		1875	..	519,392
1873	..	..	628,066				

From Cebu the exports were in

			Piculs.				Piculs.
1874	..	..	234,361		1875	..	154,922

The best fibre comes from the latitudes south of Manila, and from several islands as far as the tenth degree.

The manufacture of cloth and rope from the fibre of the plantain is not a new discovery, for the Indian natives of South America have long been in the habit of using it for these purposes. Dampier notices the process as common in the Indian Archipelago in the early part of the last century as follows: "They take the body of the tree, clear it of its outward bark and leaves, cut it into four quarters, which, put into the sun, the moisture exhales; they then take hold of the threads and draw them out; they are as big as brown thread. Of this they make cloth in Mindanao, called saggera, which is stubborn when new, wears out soon, and when wet it is slimy."

Our direct imports of Manila hemp into the United Kingdom from the Philippines have been as follows:—

Year.	Quantity.	Year.	Quantity.	Value.
	Cwts.		Cwts.	£.
1862	173,478	1876	302,882	..
1863	312,871	1877	333,344	..
1864	183,944	1878	425,866	..
1865	194,851	1879	340,786	..
1866	87,873	1880	408,639	..
1867	88,033	1881	353,770	..
1868	175,118	1882	373,231	830,033
1869	92,642	1883	330,385	747,597
1870	129,345	1884	348,344	651,831
1871	206,678	1885	383,760	664,565
1872	153,746	1886	304,523	436,755
1873	259,962	1887	353,605	588,944
1874	276,640	1888	695,579	1,230,742
1875	324,792			

THE FIG (*Ficus carica*).—The ordinary fig-tree attains an age of several hundred years, and in warm, temperate climes is a prolific bearer. The extreme facility with which it can be propagated from cuttings, the resistance to heat, and the comparatively early yield and easy culture recommend it to notice. Caprification is unnecessary. Two main varieties may be distinguished, that which produces two crops a year and that which yields but one. The former includes the grey or purple fig, which is the best, the

white fig and the golden fig, the latter being the finest in appearance, but not in quality. The main variety, which bears only one crop a year, supplies the greatest quantity of figs for drying, among which the Marseillaise and Bellonne are considered the best. The Barnisote and the Aubique produce delicious large fruits, but they must be dried by fire heat, and are usually consumed fresh.—(*Mueller*.)

The fig bears during the greater part of the year. The first ripens in Turkey about the end of June, then come the summer figs, which employ a large part of the population, and are brought to market in large quantities about the end of October and the beginning of November. Often there is a third harvest, which ripen when the leaves have fallen. The dried figs for shipment are obtained principally on the plains of Aidin, and sent by rail to Smyrna for shipment, from which port about 200,000 cwts. are sent chiefly to England, America, Austria, Russia, and Germany, and small quantities to Constantinople, Egypt, and France. Of three qualities, Aidin, Ermeli, and Elemé, the last are the most esteemed, fetching 15s. to 20s. more a cwt.

The Trojan fig is considered the best sort cultivated on Italian soil, nine-tenths of the figs grown in the vicinity of Naples are of this kind. It grows well in dry soil, is an excellent bearer, and requires no manure, but, if reared in a damp place, it should be freely pruned and earthed up. If the soil is damp, the fruit of the Trojan fig must be gathered as soon as ripe, then split in two from the stem downwards and exposed to the sun. There are several varieties of the tree grown in Sicily, some yielding a large, others a small fruit, and the fruit varies in its degree of sweetness, also in colour from white to black.

The favourite ones are the Sangiovannaro, the Sottuno, the Melinciano, and the Ottala. The last is considered the best for drying, the fruit is longer and sweeter. In orchards the distance maintained between the trees is about 26 feet. The fruit is dried in the following manner:—It is gathered when partially ripe, that is, when the fruit is more green than ripe, and immediately plunged into boiling water, and allowed to remain only a very few minutes. It is then placed in a spot sheltered from the sun, and the next morning at sunrise spread upon a platform in order that it may be flooded with sunlight, care being taken not to place it upon the ground, on account of its dampness. While drying, shallow willow-work baskets are used for holding the fruit, and these are never placed upon the ground, but kept in an erect position. At sundown the fruit is covered to protect it from the night dews or unexpected showers of rain, and this operation is continued for several days until the fruit becomes thoroughly dry. When dry it is placed in layers in small boxes or baskets, these layers being arranged very neatly and artistically, the fruit being pressed down firmly by hand until the box or basket is full, when they are securely covered and kept in a dry place for shipment.

Any rain at the end of July or during the month of August and September, when the fruit is under the process of drying, injures

the quality, by causing it to burst, hardens the skin, gives the fig a dark colour, and spoils its keeping quality.

From Portugal the annual export of figs is about 8000 tons, but varies a little, according to the crop and the quantity. From Italy the export of dried figs was 80,941 cwts. in 1884, and 128,816 cwts. in 1885.

Although the fig-tree prospers in nearly every part of Greece, it is only cultivated on a large scale, firstly, in the provinces of Messina and Calames, and, secondly, in those of Andros, Carystie, Tenos, Pylie, &c. Figs now constitute one of the principal commercial products of Greece. In 1875, 250,308 cwts. were exported. There are a large number of fig-trees cultivated in Egypt, and the yield of fruit is about 20,000 cwts.

The imports of figs into the United Kingdom have been as follows:—

		Cwts.			Cwts.
1876	.. ..	163,163	1882	.. ..	73,578
1877	.. ..	96,910	1883	.. ..	123,434
1878	.. ..	67,243	1884	.. ..	131,896
1879	.. ..	105,327	1885	.. ..	113,162
1880	.. ..	85,913	1886	.. ..	114,253
1881	.. ..	138,225			

Italy furnishes 12,000,000 to 15,000,000 lbs., Spain 4000 to 5000 cwts., and Greece and Turkey small quantities.

Among other dried fruit imported into England are French plums, dried and preserved plums and prunes. All dried saccharine fruit are subject to a duty of 7s. per cwt. on import into England. The French plums and prunes come principally from France, the dried plums from Austria and Germany.

The quantities received are shown in the following table:—

Year.	French Plums (Imports).	Dried Plums.	Prunes.
	cwts.	cwts.	cwts.
1877	10,707	796	16,766
1878	11,878	863	24,896
1879	7,274	842	8,777
1880	13,356	1,038	37,372
1881	10,088	721	12,364
1882	9,826	1,154	24,021
1883	13,937	1,814	25,343
1884	12,990	922	29,589
1885	14,388	7,648	27,504
1886	12,523	3,922	21,124

We pay France £70,000 to £80,000 for these.

The first-named, the largest and finest kind, is the Catharine variety of the *Prunus domestica*, and is usually packed in cartoon boxes; the common prune, the Julian variety, is packed in barrels. A large commerce is carried on in growing and preparing these in France, especially in the central and southern departments.

TAMARINDS (*Tamarindus indica*).—This magnificent tree, a native of tropical Asia and Africa, is cultivated throughout India, Burma, Java, and Sumatra, and is naturalized in the West Indies. The acid pulp of the pods forms the medicinal tamarind, rich in formic and butyric acid. It is shipped from Bombay and Madras to the Persian Gulf, 16,500 cwts. having been exported there in 1870. The fruit is largely used in native cookery in the East, being eaten with rice, raw or as a condiment with vegetables, pulses, fish, &c. It is dried and kept in store in almost every house in Bengal. In India very little attention is paid to the preparation of the fruit. It is simply deprived of its outer woody covering, and then stored in mass with or without some sugar. It therefore contains seeds, stringy fibres, and often bits of the pod.

It is antiscorbutic, and therefore otherwise useful and grateful as a condiment. In Egypt it is met with in flattened cakes, and is much used for making refreshing drinks. In the West Indies it is preserved in syrup, 5000 or 6000 lbs. are exported from Jamaica and small quantities from other islands. Twenty years ago England used to receive 4,000,000 lbs. of tamarinds. In preserving tamarinds, in order that they may keep well without fermentation, the first syrup poured on them, which becomes acid, is poured off and a second and even a third added. A very excellent preserve is imported from Curaçoa, made from the round or green pods in sugar with the addition of spices. The method adopted is as follows:—The green fruit, before the seeds get hard, is first peeled and then allowed to remain in a solution of lime and water for some hours, the seeds are then taken out, and the remainder stewed with sugar and spice.

This delicious fruit is almost wholly neglected, except in the vicinity of sugar estates, where it is preserved by simply pouring cane liquor on the layers in kegs for private use or presents only. When it is considered how universal is the growth of the tamarind in the East and West Indies, how heavily it bears, and how little labour is involved in getting the pods and preserving them, there certainly does appear a fair opening for enterprise.

Jamaica.—The following table shows the progress made in the export fruit trade of this island in ten years:—

Year.	Quantity.		Value.	
	1875.	1886.	1875.	1886.
Coconuts No.	2,007,893	3,711,680	£. 5,599	£. 12,249
Bananas .. bunches	58,411	1,661,704	5,590	166,170
Limes brls.	635	694	254	306
Mangoes No.	57,820	45,735	43	66
Oranges No.	4,673,820	38,862,374	3,272	52,464
Pineapples doz.	390	9,557	117	1,434
Shaddocks brls.	6	9	1	6
Tamarinds „	4,082	2,121	204	29
			15,080	232,724

Natal.—There is practically no limit to the production of fruit in this colony, except the capacity and distance of the market. Owing to increased facilities for distribution, the Cape Colony has been found a good outlet for the great varieties which are not produced there. The exports range in value from £2500 to £3000 a year. It must, however, be borne in mind that these figures very inadequately express the return from fruit-growing. In addition to the large local consumption there is a very considerable manufacture of jams, jellies, and other preserves, which are sold largely in South Africa and elsewhere.

Tasmania.—This island has long been famous for its fruit. The apples and pears of Tasmania far surpass those of Great Britain in size and appearance, and over 130 varieties are to be counted, including all the best kinds of England, Continental Europe, and America. The gross produce of apples in 1882 represented 142,217 bushels; the produce of pears was 22,271 bushels. Single pears have reached the astonishing weight of over 3½ lbs.

All the early grapes ripen in Tasmania when in favourable situations, and the later kinds ripen on walls. Excellent wine has been made here, though but few have entered upon this as a business.

Strawberries attain a remarkable size, and are more plentiful than in almost any other part of the world. Raspberries are equally abundant, and gooseberries are as plentiful and excellent as anywhere in England. The total value of fresh and preserved fruits exported in 1881 was £194,566.

For many years the fruit and jams of Hobart have been celebrated throughout the colonies of Australasia. There are seven jam factories in the colony, which shipped, in 1882, 4,200,000 lbs. of jam, valued at £100,250. The exports in later years have not been so large; in 1887, the fruit exports were valued at £91,767, and of jam at £38,134.

Fiji.—The trade in green fruit with the neighbouring Australasian colonies may be said to have commenced in earnest in the year 1877, on the occasion of a monthly line of steamers between Levuka and Sydney being subsidized by the Colonial Government. The value of fruit exported has increased from £507 in 1877 to £24,000 in 1885. The class of fruit exported has hitherto been limited to pine-apples and bananas; but the great numbers of mango-trees introduced into the colony within recent years, many of which are now about coming into bearing, justify the hope that this export will shortly be extended.

The bananas are, to a great extent, grown by natives, and bought from them by the European shippers at a price varying from 9d. to 1s. 6d. per bunch. The freight to Sydney, Melbourne, and Auckland is 1s. per bunch, and the fruit is sold in those markets at a price varying from 3s. to 5s. per bunch.

The pine-apples are almost exclusively grown on the plantations of Europeans. The productive powers of the colony in respect to the growth of fruit are unlimited. Oranges, limes, citrons, lemons, guavas, and other fruits grow in a wild state throughout the

country, attention not having yet been turned to the profit which might be derived from the systematic cultivation of those products.

As these articles have proved a source of wealth in the West Indies and other tropical and sub-tropical countries, it may be anticipated that they will not for a much longer space of time be neglected here.

The exports in 1885 consisted of 277,973 bunches of bananas, 80 cases of dried fruit, and 5095 cases of pine-apples.

Large banana plantations have been started, and the natives enter with energy into the trade.

The passion fruits are among the most delicate and refreshing of tropical fruits, and some of them have been successfully introduced in England. The most common are the granadilla (*Passiflora quadrangularis*), the homme d'or, or water lemon (*P. laurifolia*), the sweet cup (*P. edulis*), and the calabash sweet cup (*P. maliformis*). The granadilla is a large fruit, somewhat resembling a melon, but rather more oblong; its size is frequently fifteen to sixteen inches long, with a diameter of five or six inches. The fruit is much valued for its soft and delicate pulp, which is very cooling and refreshing in hot climates. It has a sweetish, acid taste, and when ripe is of a purplish colour.

THE MANGO (*Mangifera indica*) is the apple of the Tropics, and a most nutritious and wholesome food, as well as a dessert fruit. In the "Flora of British India" about twenty distinct species of *Mangifera* are described, and it is stated that there are in all about thirty species. Originally an East Indian tree, the mango has become thoroughly naturalized in the West Indies, and is forming large groves in waste places in Jamaica, where negroes, horses, pigs, goats, and even fowls feed upon the fruits for nearly four months of the year.

It is often asked, Can nothing be done with the thousands of tons of mangoes annually produced in Jamaica and for the most part left to lie on the ground and rot for want of using? The mango tree in all its various forms has now been thoroughly naturalized in the island, and since 1790 it has spread spontaneously and abundantly everywhere. It especially affects land thrown out of cultivation, and the sides of roads and streams where its seeds are cast aside by men or animals, and it practically re-clothes the hills and lower slopes with forest. It thus enables the land to recuperate its powers under its abundant shade-giving foliage.

During the mango season (May to September) large quantities of the fruit are consumed by the negroes, who practically live upon it in localities where it is plentiful. All animals, without exception, are fond of the mango.

As to the utilization of the fruit of the mango on a large scale there is a vast and practically untouched field here for the chemistry of organic products. Some would suggest that the best varieties might be canned or preserved for exportation, or made into preserves and jellies; others that the grosser kinds might be

utilized for the production by distillation of a useful spirit; others that a starch compound might be prepared from the inner layers of the flesh next the seed; whilst, lastly, taking into account the present commercial value of glucose, the peculiar form of sugar which exists in grapes and other fruits, the ripe mango might be made to yield large quantities of this at a small expense.

The export trade in mangoes is small and expanding but slowly. The export in 1884 was 126,968, of the value of £180. The fruit is very tender, and requires care and judgment in gathering, as well as in the necessary packing. Gathered a little before they are ripe and kept in a cool storage, there is no reason whatever to doubt that mangoes might become as common in the markets of London and New York as the pine-apple.

The celebrated No. 11 mango is thought by some to be even better than the newly-introduced East Indian kinds. This, however, is purely a matter of taste. The East Indian kinds being free from the state of "stringiness," which is associated with all the old Jamaica sorts, give them a great advantage, and as, added to this, they possess thicker and harder skins and smaller seeds, they are much better adapted for export purposes.

In the East the natives consider this the most delicious fruit in India, but Europeans do not appreciate the varieties most admired by the natives. The unripe fruit is sliced and cooked in curry, made into pickles, and also sliced and sold in the bazaars in the dried state; ripe fruits are made into preserves and jams by being boiled and cooked in syrup. The seed inside the stone is used for food by the poorer classes, especially in times of scarcity.

There are good mangoes and bad mangoes. In the former the pulp is deliciously flavoured, and of a consistence somewhat like butter; in the latter it is stringy, and tastes strongly of the carrot with a little flavour of turpentine. There are small, yellow, and rose cheeked mangoes, large mangoes, both yellow and green. The thick juice is by the natives squeezed out, spread on plates, and allowed to dry, in order to form the thin cakes known as *Amsatta*.

Dr. Bonavia, of India, writing recently on this point in the *Journal of the Society of Arts*, remarks: "In India there are hundreds of varieties of this unique fruit. Fifty or more kinds might be named, which for texture and exquisiteness of flavour would more than favourably compare with the same qualities in the nectarine and the peach. It is only those who have been a long time in India, and who have had opportunities of trying the choice varieties of mangoes, that have any conception how good this fruit is. Those who have not had opportunities of tasting good mangoes have a notion that this fruit is like so much 'tow and turpentine.' It would be as accurate to state that the characters of the crab apple are those of all the hundreds of apples to be found in Europe. The uncultivated seedling mangoes are generally fibrous, but this does not at all prevent their having very often a very exquisite flavour. To enjoy these good seedling mangoes they must be sucked, and the native has here an advan-

tage over the European. The former sucks his mangoes, and therefore enjoys a far more extended range of fine flavour, while the civilised European wants to eat his with knife and spoon. The choicest mangoes, of which there are scores, have not a trace of fibre in their pulp, and not a trace of turpentine flavour, except, perhaps, a *soupcçon* of it in the skin. When the skin is removed, if you shut your eyes while eating them, you might often be deluded into the idea that you are eating nectarines, figs, &c., and sometimes a delicious compound with a dash of nice mushroom flavour in it. The flavours of the choice mangoes are infinite, and their size varies from that of a small hen's egg to that of a good-sized melon or ostrich egg. The colours when ripe are either citron-yellow, green speckled with yellowish dots, yellowish white, yellow with a fine crimson cheek, &c. Their shapes are either round, flat, oblong, heart-shaped, &c."

In India mangoes are always plucked when still under-ripe, and then they are ripened completely among straw. Even the choice kinds when under-ripe are sour and hard; when quite ripe they are perfect, and their flavour various and unique; when over-ripe they lose their rich distinctive flavours, and are not nice.

The choicest variety now grown in the North-West Provinces would seem to be the "Takàri" mango of Futtehgarrh; the "Singra" mango of Benares is either the same variety, or one closely allied to it; both are rather flat. When ripened to perfection, and put under ice for some time, their pulp is like a delicious ice-cream, and can be scooped out with a spoon as easily as an ice-cream or a stiff curd. The spoon does not fill with luscious juice, as in the aforesaid "new" mango; the pulp is compact, and of the consistence of ice-cream.

Delicious mangoes are now grown in Siam, but those raised in Singapore have mostly an intensely terebinthine flavour. In Cochin China there are more than 2500 acres under mango trees.

SECTION VII.

THE SPICES OF COMMERCE.

BLACK PEPPER is the dried immature fruit of *Piper nigrum*, a climbing plant attaining the height of from 8 to 12 feet. The berries, or, botanically speaking, drupes, are at first green, then red, and if left still longer ungathered turn to black; but before this latter change takes place the berries are gathered by hand and dried in the sun, the result being an entire change of appearance; instead of a red, smooth berry, a black, or reddish-black pepper-corn, with the cortex contracted and shrivelled in such a manner as to form a varied network, is obtained.

Pepper is one of the most wholesome and useful of the spices. With persons in ordinary health it has the effect of stimulating the stomach greatly to the performance of its functions, and is peculiarly serviceable to persons who are of cold habit or who suffer from a weak digestion. Used in moderation, pepper decidedly promotes the appetite and digestion; but its excessive use tends to vitiate the gastric juice and injure the stomach, besides provoking inordinate thirst; and this remark applies generally to all spices.

Many of the natives of India esteem pepper as a stomachic, and drink a strong infusion of it in water by way of creating an appetite. They have also a method of making a fiery spirit of fermented fresh pepper with water, which they use for the same purpose.

Living mostly on a vegetable diet, and often consuming large quantities of crude substances, the natives of India have naturally sought to give a zest to their simple diet, and to render their meals more digestible, by the use of pungent and aromatic condiments. To a native of India a meal is nothing unless it embraces a curry, and a pungent decoction, known as pepper-water, is freely consumed when a curry cannot be had. The Hindu, as a rule, likes his curry hot with pepper and cayenne, and rich with ghee (clarified butter), and if these conditions are met he is not overfastidious as to flavour. The Mahomedan, on the other hand, is a great connoisseur in condiments, and has expended much ingenuity in inventing curries, chutnies, pickles, and such like.

To the native of India spices and condiments are indispensable. Dr. Watts tells us he will eat contentedly by the stream-side a

meal of uncooked flour and water, provided it is flavoured with a few green chillies. No luxury is more extensively indulged in than *pan*, the stimulating preparation of betel leaf (*Piper betel*), lime and betel nut (*Areca Catechu*), which is chewed by nearly every native in India. Turmeric is an essential ingredient in curry, the national dish. The total value of the foreign trade in spices and condiments in India (imports and exports) exceeds £1,000,000 sterling. The principal articles of this trade are betel nuts, pepper, ginger, cloves and cardamoms, besides minor ones, such as coriander, cumin, fenugreek, turmeric, and cinnamon.

QUANTITY of SPICES EXPORTED from INDIA, YEARS ENDING MARCH 31.

	Lbs.		Lbs.
1877	18,247,955	1883	20,947,105
1878	14,306,269	1884	18,514,377
1879	22,382,834	1885	22,767,190
1880	18,651,301	1886	25,831,355
1881	17,671,838	1887	31,218,151
1882	15,144,303	1888	24,381,808

EXPORTS from INDIA, YEARS ENDING MARCH 31.

Kinds.	1885.	1886.	1887.	1888.
	lbs.	lbs.	lbs.	lbs.
Cardamoms	264,750	299,324	295,446	155,201
Ginger	8,764,221	10,318,411	14,927,926	9,510,564
Pepper	6,098,694	6,146,143	9,069,610	7,151,836
Other sorts	5,852,555	7,067,477	6,940,593	7,564,207

The value of these spices exported was, in 1887, £612,188, and in 1888, £521,786.

The black pepper imported into Great Britain principally comes from India, Malacca, Java, Sumatra, and Borneo.

The varieties of pepper which enter into commerce are Pinang, Tellicherry, Sumatra, Malabar, Trang, Siam, and Cochin, these names indicating the localities from which they are derived.

The empire of Acheen was the chief producing country for pepper. It is, however, cultivated in various parts of the island of Sumatra, and at Bantam. The culture, as far as quantity is concerned, may be said to be almost restricted, at present, to the east and west coasts of Sumatra; the production, which used to reach nearly 40,000,000 lbs. annually, has, however, greatly declined of late years.

The pepper that comes to the Batavia market is received from the Lampong islands off the Sumatra shores; the quantity produced there is estimated, in good seasons, at about 4,000,000 lbs. annually. The crop is plucked in September and following months; therefore, up to the end of January, about 2000 piculs reach the Batavia market monthly, while from February to August the monthly receipts hardly reach 500 piculs.

The pepper produced in the Lampong district in 1871 was 14,000 piculs; in 1872, 20,537 piculs. In 1872 the shipments from Java consisted of 24,256 piculs of white, and 30,695 of black pepper.

The production of black pepper in the Lampongs and Sumatra was nearly trebled in 1886 over the previous year. The following figures give the export:—1875 to 1884, average 1,370,000 kilos.; 1885, 970,000 kilos.; 1886, 2,487,000 kilos.

The cultivation has extended, and is prosecuted with vigour in the west of Java, but the soil of Sumatra is found best suited for it. A large company, under the management of Baron de Lapeyrie, has been established at Langtrat to grow pepper on a large scale. The shipments of white pepper were 1520 kilos. in 1885, and 2500 in 1886.

The imports of pepper into China are about 40,000 piculs, and all from Siam.

The unusually high prices of recent years have caused a considerable extension in the cultivation of the plant in the Malay peninsula, which used to produce 4,000,000 lbs., especially grown by Chinese settlers. In 1888 a company was formed, most of the members being European residents of Singapore, to work a concession of 2000 acres in Salangore, on which pepper was to be the staple cultivation.

The Chinese mode of pepper planting consists in setting the pepper vines from 6 to 8 feet apart. Along with the young plants, poles are placed on the ground, round which the growing plants are twined and tied. After having grown for eight or nine months, the plants are taken down from the poles and buried in the earth, all except the tops. The buried part takes root and strengthens the plant. Calcined earth, with refuse and rotten fish, are used for manure. A well-drained, sloping hill-side is best for pepper-growing. As a rule, the berries are three or four years old. The Chinese calculate the yield of a pepper-vine to average as much as 4 lbs. The cost of production with them cannot be ascertained, even approximately.

The importation of pepper into the port of Marseilles has been as follows, in tons, from—

Year.	British India.	Dutch India.	Other Countries.
1872	240	849	393
1873	753	87	336
1874	1,357	1,139	375
1875	1,928	297	899
1882	1,203	474	478
1883	1,418	472	438
1884	1,235	248	179
1885	975	290	452
1886	1,438	331	57

Showing an average import of about 2000 tons.

Sixteen years ago, Acheen used to be the country exporting

most pepper, but the war there almost entirely stopped its cultivation, and the population were so reduced that there was little chance of pepper-growing being resumed on any scale. In Singapore and Johore, the soil, very poor to commence with, is nearly all used up. In Sarawak the cultivation is extending, and is a source of great profit to the grower and to the country generally; but the soil is against any very great extension, except in some favoured spots. Owing to these causes, the price of pepper is continually advancing. Fourpence a pound used to be looked upon as a paying price to the grower; but for a long time past the price has been rising about a halfpenny a year, until it now stands at $7\frac{1}{2}d.$ per lb., and the profits on its cultivation are undoubtedly something enormous.

Pepper seems to flourish in but few countries, Borneo and Sumatra being almost the only two; and owing to the disturbed state of the latter, its cultivation in the former—and in British North Borneo particularly—seems likely to be largely extended. In fact Borneo may in time become one of the largest pepper producing countries in the world.

Mr. W. M. Crocker has written a pamphlet on the cultivation of pepper, containing very much valuable information, which will be found useful for reference.

EXPORTS from JAVA and MADURA.

Year.	Clove Pepper.	White.	Black.
1878	59,175	31,422	627,289
1879	149,582	100,706	1,820,645
1880	59,175	13,349	809,474
1881	295,705	16,441	1,512,835
1882	588,795	2,000	2,866,399
1883	301,740	..	1,324,149

There was received in Holland in :—

	Pepper. Lbs.		Pepper. Lbs.
1878	705,000	1881	371,300
1879	1,372,000	1882	524,700
1880	420,000	1883	272,300

Jacobson and Sons' circular.

The exports of black pepper, on private account, from Netherlands-India, were—

	Lbs.		Lbs.
1876	627,000	1881	5,824,000
1877	3,303,000	1882	7,358,000
1878	2,104,000	1883	6,201,000
1879	5,865,000	1884	4,451,000
1880	4,251,000	1885	5,194,000

The distinction of the two kinds is shown below :—

	Year.	Black.	White.
		lbs.	lbs.
	1875	3,733,011	1,706,734
	1880	4,260,970	1,458,279
	1885	5,194,532	1,344,175

RECEIPTS OF PEPPER in EUROPE (in bales of 1 cwt.).

	Year.	Imports.	Deliveries.	Stock.
	1878	355,400	357,700	176,000
	1879	295,200	328,000	132,200
	1880	264,500	263,100	111,800
	1881	265,000	268,500	132,400
	1882	287,800	333,500	86,800
	1883	370,200	347,100	104,200
	1884	294,700	303,100	79,100
	1885	286,200	287,200	78,000
	1886	271,700	278,400	74,100
	1887	327,900	310,500	97,400

EXPORTS OF PEPPER from INDIA.

	Year.	Quantity.	Value.
		Lbs	£
	1884-85	6,098,694	192,597
	1885-86	6,146,143	214,689
	1886-87	6,064,186	317,129
	1887-88	7,151,836	293,137

The pepper vine is indigenous to the forests of Malabar and Travancore. For centuries pepper has been an article of exportation to European countries from the western coast of India. Although a product of many countries in the East, that which comes from Malabar is acknowledged to be the best. In 1874 there were 23,179 pepper vines scattered over the territory of French India.

The exports of pepper from Malabar in the seasons ending June 30 were as follows :—

				Cwts.					Cwts.
1879-80	..	..	..	36,955	1882-83	..	..	..	101,483
1880-81	..	..	..	60,634	1883-84	..	..	..	47,148
1881-82	..	..	..	51,238					

Its cultivation is very simple, and is effected by cuttings or suckers put down before the commencement of the rains in June, in a rich and tolerably moist soil. In three years it begins to bear, each plant yielding on an average 2 or 3 lbs. of pepper per annum up to fifteen or twenty years, after which they begin to decline.

The crop is gathered in March or April; the fruit is plucked when not quite ripe, and usually dried on mats in the open air. White pepper differs from black only in being deprived of the outer skin by a short maceration in pure water, and subsequent gentle rubbing; it is somewhat smaller, of a greyish white colour, and with a less aromatic taste.

The small round berry-like fruit grows somewhat loosely, to the number of twenty to thirty, on a common pendulous fruit-stalk. They are at first green, then become red, and if allowed to ripen, yellow; but they are gathered before complete maturity, and by drying in that state turn blackish-grey or brown. When one or two berries at the base of the spike begin to turn red, the whole spike is pinched off. Next day the berries are rubbed off with the hands, picked clean and dried for three days in the sun, or in bamboo baskets near a gentle fire.

The plant is capable of growing to a height of 20 or 30 feet, but for the sake of convenience it is usually kept low, and is often trained on poles. In places where no vines occur naturally, the plant is propagated by setting slips near the roots of the trees on which it is to climb. An acre of land will bear 2500 plants, and as they require but little care, the cost of cultivating and bringing into bearing one acre does not exceed £4 at the most, and as the annual yield when the plants come into bearing is worth upwards of £80, the investment is a very profitable one.

The pepper vine is hardy and easily cultivated, and as its produce is of such great commercial importance, it may be well worth trying whether it could not be successfully grown in other localities under congenial conditions of climate and soil. The choice of a proper site for the plantation is a consideration of the first importance. Level ground lying along the banks of rivers and rivulets is to be preferred, both on account of the vegetable mould commonly found in soil so situated, as well as of the facilities of water-carriage which such a situation generally affords. But the land should never be so low as to be liable to inundation. Declivities, unless very gentle, are to be avoided, because the soil loosened by culture is liable to be washed away by heavy rain. Plains, whether naked or covered with long grass, will not answer, unless broken up well with the plough and enriched by manure. Above all, the pepper vine loves a moist climate.

In Malabar the pepper vine is often raised from seed, and experienced men have been known to express a decided preference for this mode of propagation, because the vine so raised bears for fourteen years. On the other hand, though the cuttings yield for only seven years, or just half the period, the crops they give are greater, and the berries are both of larger size and of superior quality. It is for this reason, therefore, that in Malabar the cultivation is practised with cuttings or suckers, which are put down into the ground before the rain sets in, in June. The soil must be rich, but it should also be free from any accumulation of moisture below, or the young plants are apt to rot. The cuttings are usually

planted at the foot of trees with rough bark, on which the vine as it grows finds a support. The creeper will climb up about 20 or 30 feet, but it is purposely kept lower for facility of collecting the berry. During its growth every sucker is removed, and it is pruned, thinned, and kept clear of weeds. After the berries have been gathered, they are dried on mats by exposure to the sun, when they change colour from red to black. Much experience is required as to the proper time for gathering. The trees which are generally selected in Malabar to support and shade the pepper vine are the jack, the mango, the cashew-nut, and other similar trees; so that the pepper is an additional crop which the cultivator gathers from his orchard lands, even while they also are bearing.

Although the quality of the pepper grown in Malabar is considered to be better, the largest quantity of the spice is produced in Sumatra, where the method of cultivation is somewhat different. In that island the pepper vine is raised in plantations regularly laid out. The ground is previously cleared of wood, ploughed up, and sown with rice, among which the cuttings are put down at a distance of five feet from each other in every direction, with the green sapling of some tree of quick growth and rough or prickly bark, which soon takes root and affords support and shade to the vine as it grows. It grows most luxuriously in moist, rich soils, provided it obtains good shade. Like most other vegetable productions in hot climates, it requires but little trouble or attention after it has once been planted, other than watching the proper season for collecting the berry. In Sumatra, the layers or cuttings are put down in September. The plant is afterwards left to itself for twelve or eighteen months, it is then buried with all its branches, so as to leave only a small arch of the stem above ground. From this arch new shoots sprout out, three or four of which are allowed to climb up the tree, and are expected to produce flowers and fruit in a year after. It is inferred that, by this practice, the strength and vigour of the plant are so much increased by the multiplication of its organs of nourishment, namely, the roots, that it will not only yield a larger crop of flowers, but also bring out its fruit in the greatest perfection. The neglect of this precaution might seriously affect the out-turn of a crop, both in quantity and quality.

The vine produces fruit in two seasons of the year. The flowers of the principal crop appear in September, with the rains of the first monsoon. In the latter end of December the berries begin to ripen, and are gathered in January, as they get to maturity. The finest berries in the second stage towards maturity are selected for making white pepper. The process in Sumatra consists in steeping these berries for three or four days in running water, and then drying them well in the sun. The flowers of the second crop appear in March and April with the rains of the little monsoon; and the fruit ripens and is gathered about July and August; it is probably to the want of moisture at the time the fruit is setting, that the inferior quality and scantier out-turn of this crop is to be attributed. One thousand vines are estimated to yield about 10½

owts. of pepper in the course of a year: so that each vine may be reckoned upon as producing $1\frac{1}{2}$ or 2 lbs. of the spice.

The black berries of *Embelia Ribes*, Burm., are often used to adulterate it in parts of India, as they so much resemble pepper as to render it impossible to distinguish them by sight or by any other means, and they are, withal, somewhat spicy. Although there is a very heavy penalty on adulteration in this country, ground pepper is frequently sold sophisticated with starch, mustard husks, linseed and capsicum.

The following have been the imports of pepper into the United Kingdom since the year 1840, as given in the Board of Trade returns:—

			Lbs.				Lbs.
1840	..	..	5,927,959	1880	..	..	21,729,968
1850	..	..	8,082,319	1887	..	..	29,704,898
1860	..	..	12,810,040	1888	..	..	28,704,898
1870	..	..	19,339,491				

There would seem to be extraordinary fluctuations in the quantity of pepper taken for consumption here and stocks held.

The average consumption of pepper in the United Kingdom from 1848 to 1862, when there was a duty levied, was from 3,500,000 lbs. to 4,000,000 lbs. per annum, it is now about 10,000,000 lbs.; the average quantity re-exported in the three years ended 1888 being about 19,500,000 lbs.

A pepperwort, the small red carpels of which inclose black shining seeds of an aromatic odour, and a peculiar pungent flavour, with an acrid after-taste, being stimulant, stomachic, and astringent, are used for seasoning purposes in China. They are brought from the Szechuan province to Ning-po, and are worth \$50 a picul.

Ethiopian pepper (*Xylopia Æthiopica*, N. Rich., *Habzelia*) is used by the natives of Western Africa as an aromatic stimulant, and also as an anthelmintic.

CHILLIES AND CAYENNE PEPPER.—The Cayenne pepper of commerce is obtained chiefly from the pulverised chillies or fruit pods of one or two species of capsicum (*Capsicum annuum*, Lin., and *C. fastigiatum*, Blume). But a very large number of species and varieties of capsicum are grown and used as condiments in all tropical countries, where there appears to be a greater necessity for pungent seasonings.

The generic botanical name of Capsicum is derived from "kapto," to bite, on account of the hot pungent qualities of the pericarp.

Among the principal species grown may be named the following:—The cherry pepper or round chilli (*Capsicum cerasiforme*, Willd.); the bonnet pepper (*C. tetragonum*, Mill.); the bell pepper (*C. grossum*, Lin.); the spice or goat pepper (*C. frutescens*, Lin.); and the bird pepper (*C. baccatum*, Lin., or *C. fastigiatum*). The last-named two are more acrimonious than the others. The fruits of these several species are of various forms—round, oblong, cordate or horned, and

either scarlet or yellow ; in some varieties they are so little pungent as to be used sliced in salad, in others they are intolerably biting till the mouth becomes accustomed to them by habit. The acrid resin (*capsicine*) in the fruit renders them hot, pungent and stimulating. Contrary to general opinion it has been found on analysis that the seeds after removal of the pericarp, and thoroughly washing and drying them, are entirely devoid of acridity and pungency.

Red pepper may be termed one of the most useful condiments in hygiene. As a stimulant and auxiliary in digestion it has been considered invaluable, especially in warm countries. There are always a few of these shrubby plants grown about the dwellings in the tropics to supply the daily wants of the table, as they are generally gathered and eaten just before fully ripe.

Unfortunately, in England, Cayenne pepper is very frequently adulterated, and hence reliance can only be placed on purchasing from respectable wholesale houses, which have a reputation and character for probity and the sale of genuine articles. Venetian red, red ochre and cinnabar are often added to darken the colour, although this is no sign of its excellence, for the Nepal and many other Cayenne peppers are extremely light-coloured, as they will naturally be if made with the ground seeds alone unmixed with the redder husks of the fruit capsule. As Cayenne pepper when obtained pure and used in moderation promotes digestion and so prevents flatulence, and is hence undoubtedly serviceable to persons of languid digestion, so if adulterated with poisonous substances it is calculated to be highly injurious.

The French names for capsicums are "piment," "poivrons," "pevrots," and "corail of the gardens." The Spanish name for this spice is "agi": it was formerly known under the name of Calicut pepper, and in Gerarde's time, nearly three centuries ago, it was sold here under the name of Ginnie pepper, and it still bears the name of Guinea pepper in France.

The natives of Brazil consume great quantities of these peppers, preferring the small red ones, which are of excessive pungency. When they have no fish they boil several pounds of these peppers in a little water, and dip their mandioca bread into the fiery soup thus formed.

Chillies are largely used as a condiment, and also employed as a stimulant and carminative in medicine. There are two kinds common in India: the ordinary chilli, the fruit of *C. annuum*, and the bird's eye chilli, the fruit of *C. fastigiatum*.

There is an enormous consumption of chillies in India, as both rich and poor daily use them, and they form an important ingredient in the curries and chutneys in general use, when ground into a paste between two stones, with a little mustard, lard, oil, ginger and salt, this forms the only seasoning which the millions of poor in the East can obtain to flavour their insipid rice.

In 1870 there were more than 70,000 acres under culture with capsicums in the Madras Presidency, the largest portion being in Kistna. The exports from Madras in the four years ending 1855

were 81,042 cwts. Bombay imported in 1873, 5567 cwts., principally from the Madras Presidency, and exported 3323 cwts. In 1871 Singapore imported 1071 cwts., chiefly from Pinang and Pegu. The spice is largely consumed by the Chinese. 409½ piculs of dried chillies were shipped from Chefoo in 1871 to other Chinese ports. *C. annuum* is extensively cultivated in Bengal; there is a variety growing in Nepaul (*C. Nepalensis*) the taste of which is far more pungent and acrid than any of the preceding named species.

Chillies or pod peppers are much used for flavouring pickles. By pouring hot vinegar upon the fruits all the essential qualities are procured, which cannot be effected by drying them, owing to their oleaginous properties; hence chilli vinegar is in repute as a flavouring substance. In Bengal the natives make an extract from the chillies, which is about the consistence and colour of treacle. A form of soluble Cayenne was sent from British Guiana in 1867 in the Colonial collection forwarded to the Paris Exhibition.

Chillies are imported here from the West Indies, Western Africa, Zanzibar and Natal, but there are no reliable statistics as to the quantity we receive, although it has been estimated at as much as 80 tons annually.

In Natal the capsicum plant grows in perfection, and yields a profit to a limited number of growers. The export of Cayenne pepper has averaged for ten years £600 per annum, exclusive of inland and local consumption. But the export has been declining for some years. The shipments of cayenne in 1880 were only 17,277 lbs., but in 1883 187 cwts., valued at £510.

In the West Indies the sorts grown are, *C. frutescens*, Lin. *C. baccatum*, chillies for Cayenne pepper; and *C. annuum*, Spanish pepper.

Monteiro says the chilli pepper is the universal condiment of the natives of Angola. It grows wild everywhere in Western Africa in the greatest luxuriance. It is eaten either freshly gathered or after being dried in the sun. It has a most violent hot taste, but the natives consume it in incredible quantities; their stews are generally of a bright red colour, from the quantity of the pepper added, previously ground on a hollow stone.

GINGER.—After Pepper, Ginger probably ranks next in importance for the quantity produced and consumed, and the aggregate value of that which we receive. The declared value of all the spices we import averages about £1,400,000, of which pepper stands for more than two-thirds. Cinnamon is valued at about £44,000, whilst ginger has now reached about £135,000, and this is nearly all consumed here. According to Hanbury, ginger must have been tolerably well known in England even prior to the Norman Conquest. The plant affording it was known to Marco Polo, who speaks of observing it both in China and India.

The root-like stem of *Zingiber officinale*, Rosc., is cultivated in very many of the warmer parts of the world for local use, but only in a few localities on an extensive scale for shipment to

supply European wants. Of this well-known flavouring condiment several varieties are known in trade, distinguished by their quality, place of growth, &c. Gingers are either "coated" with the shrivelled rind on, or "scraped" by having it removed. Ginger is sometimes bleached by chloride of lime, or whitewashed with lime and water. This spice is but little used on the Continent compared with England.

The varieties of ginger which enter into commerce are Jamaica, Cochin, Brazil, and Africa. The first three are scraped gingers, the last-named is coated ginger—that is to say, it still retains its epidermis. Jamaica ginger is the sort most esteemed, and next to it the Cochin. It is generally imported in bags of 1 cwt.

The best racemes are dried in the sun after being cleaned from the radicles and earth, and are known as white ginger. The inferior qualities are steeped in boiling water before being sun-dried, and are known as common or black ginger.

Good ginger should be fresh, dry, heavy, not brittle, of a reddish-grey exterior. The interior should be resinous and of a pungent taste.

In China the racemes, when young, are steeped in boiling syrup and exported as a sweetmeat as preserved ginger.

The following table shows our sources of supply in 1875 and 1886:—

From—	1875.		1886.	
	Quantity.	Value.	Quantity.	Value.
British West Africa	cwts. 9,900	£ 19,887	cwts. 8,355	£ 13,351
East Indies	30,307	85,384	64,577	117,039
British West India Isles ..	15,215	54,955	7,697	21,844
Other British possessions ..	1,481	3,586	100	150
Total	56,903	163,812	82,775	156,172

Ginger, it will be perceived, comes to us chiefly from three quarters, the East and West Indies and the Western Coast of Africa. The total imports of ginger into the United Kingdom have been as follows:—

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	cwts.	£.		cwts.	£.
1867	42,834	95,398	1880	49,962	109,545
1870	33,854	60,973	1885	77,337	134,979
1875	56,880	163,951	1888	69,229	130,207

Several of the West Indian islands used to grow ginger, especially Barbados, Hayti, and Jamaica, but the cultivation for export is chiefly now confined to Jamaica.

In Jamaica it is propagated by division of the root, the smaller

pieces or protuberances being set, each of which throws up two different stems. The first bears the leaves, and rises sometimes to the height of 3 feet or more, though its usual growth seldom exceeds 16 or 18 inches; when this spreads its leaves and grows to full perfection, the second stalk springs up, which is also simple and furnished only with a few scales below, but at the top is adorned with a roundish squamose flower-spike, and seldom rises above two-thirds of the height of the others. The land having been well cleared and trenched, the ginger is planted about March or April. It rises to its height and flowers about September, and fades again towards the end of the year. When the stalks are wholly withered, the root is thought to be full-grown and fit to dry, which is generally done in January and February following. When these are dug up, they are picked and cleaned, and scalded gradually in boiling water. After this they are spread out in the sun to dry, from day to day, until sufficiently aired for packing. The larger spreading roots are generally called "hands" in Jamaica, and will occasionally weigh half a pound; they are also termed "races."

The price obtained for Jamaica ginger far exceeds that realised for ginger grown in any other country. Not only does this island produce ginger of the finest-known quality, in the production of which peculiar care is bestowed upon its cultivation and in amputation, but it also produces ginger of the most ordinary quality, to the production of which no particular attention is devoted. The value of the superior article averages over £8 per cwt. and that of the ordinary quality from £3 to £4. This latter is the standard price for nearly all the ginger sold in commerce, excepting the celebrated Jamaica product. A very large trade might be carried on in the export of preserved ginger. The land under culture with ginger varies. In 1876 there were 323 acres and in 1880 only 135 acres.

The following have been the exports of ginger from Jamaica of late years:—

	Lbs.		Cwts.	
1866	 1,550,166	1870	 5,431	
1867	 1,728,075	1871	 5,643	
1868	 2,036,921	1872	 5,355	
1869	 1,261,873	1873	 7,282	
		1874	 10,551	£.
		1885	 12,313	value 20,169
		1886	 11,564	„ 20,690
		1887	 About the same.	

The ginger plant is extensively cultivated in India, from the Himalayas to Cape Comorin. It is not exactly known to what country the plant is indigenous, though Ainslie states it to be a native of China, while Joebel asserts that it is a native of Guinea. In the Himalayas it is successfully reared at elevations of 4000 or 5000 feet, requiring a moist soil. The Malabar ginger, exported from Calicut, is the produce of the district of Shernaad, situated to the south of Calicut.

In the Dacca district the natives cleanse the roots in boiling lime

water, which probably injures much of the fragrant pungency; whereas in the West Indies, they use simply plain water. The leaves and shoots of the broad-leaved ginger (*Z. Zerumbet*) are used as greens in Bengal. It grows wild in the Concan, and in the woods about Calcutta. The underground stem of this species resembles that of ginger, but is bitter as well as aromatic. The root-stocks of *Alpinia Galanga*, *A. racemosa*, and *A. Allughas*, have somewhat similar aromatic and pungent properties, and are frequently used as substitutes for ginger.

In India the cultivation is carried on in the Hill States as follows. The best "races" of the previous year's crops are selected and placed in a corner of the house, and smeared over and covered with cow dung to prevent them from becoming dry.

When the first rain falls, the land is ploughed two or three times, and then divided off into beds with a little raised edge round each bed, taking care to make openings to let superfluous water run off; for if water lodges on the crop the roots will rot. Little pieces of the roots are then buried 3 inches deep in the soil at intervals of 9 inches. The field is covered with the leaves of trees to keep the soil moist, and over these manure is spread to the depth of half an inch. When it rains the water, impregnated with manure, filters through the leaves to the roots. Artificial irrigation is given after the rains. When the plants are about 2 feet high, to every shoot there will be found about eight rhizomes, or parts of the root. These are dug up and buried in another place for a month, then taken up, exposed to the sun for a day, and are fit for use. A begah of land requires eight maunds of ginger to plant, and yields 32 maunds for a first-rate crop. Ginger, fit for planting, sells at 8 to 10 seers for the rupee; that for use 24 to 32 seers the rupee. In order to dry ginger into "sonth," or for keeping, the fresh roots are put into a basket, which is suspended by a rope, and then two men, one on each side, pull it to and fro between them by a cord attached, and thus shake the roots in the basket; this process is carried on for two hours every day for three days. After this the roots are dried in the sun for eight days, and again shaken in the basket. The object of the shaking is to take off the outer scales and skin of the roots. Two days' further drying completes the process, and the "sonth" sells for 3 to 4 seers the rupee. Turmeric is cultivated in the same manner; when ready it is dug up, steeped in hot water a day and a night, and then dried.

Ginger is cultivated in many parts of India, for its rhizome is used as a condiment. The export trade has increased considerably, and promises a still greater increase in the future. They were only 15,000 cwts. in 1870, but now exceed 100,000 cwts.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	lbs.	£		lbs.	£
1883-84	..	106,097	1886-87	14,927,926	199,311
1884-85	8,764,221	156,857	1887-88	9,510,564	140,812
1885-86	10,318,411	154,835			

The African ginger is grown chiefly in Sierra Leone; about half that produced comes to England, and the other half goes to America. Our total imports from West Africa have been as follows:—

	Cwts.		Cwts.
1869	9,566	1878	6,624
1870	6,855	1879	11,951
1871	5,948	1880	3,142
1872	6,167	1881	645
1873	7,655	1882	4,067
1874	8,813	1883	4,600
1875	9,843	1884	6,053
1876	11,031	1885	8,355
1877	11,937	1886	9,763

Ginger is a good deal grown in China, and largely used in its fresh state as a condiment, and in medicine. Some small quantity is exported dried, but it is black and hard, and not much appreciated in commerce.

Ginger also appears in European commerce as a succade, the young shoots of the rhizome being peeled and preserved in syrup. For this purpose the rhizomes are lifted while they are yet tender and full of sap, before they have become hard or woody; the roots are carefully picked and washed, and afterwards scalded till they become tender enough for the purpose; they are then put into cold water, and scraped and peeled gradually. This operation may last three or four days, the water on the roots being changed frequently. When thus prepared, they are put into jars and covered with the syrup, and this is changed two or three times, when they are ready for shipment.

The quantity of preserved ginger imported into England ranges from 300,000 to 600,000 lbs. of the value of £11,000 to £25,000, and is received entirely from India and China. The mode of preserving it is to steep the racemes in vats of water for several days, changing the water once. When taken out it is spread on tables and well pricked or pierced with bodkins; they are boiled in a copper cauldron, then steeped for two days and nights in a vat with a mixture of water and rice flour. After this they are washed with a solution of lime boiled with an equal weight of sugar, and a little white of egg is added to clarify. After the ginger has been boiled a second time it is put up in small porcelain jars for market.

NUTMEGS.—This tree is principally grown in the Amboyna Islands, Banda, and the other Moluccas. It is also cultivated in Java, Sumatra, Borneo, and other islands of the Archipelago. Each tree produces about 3 lbs. of nuts and 1 lb. of mace. The tree which produces these spices is the *Myristica moschata*, Thunberg; *M. fragrans*, Houttuyn; *M. aromatica*, Lam.; *M. officinalis*, Lin.; a native of the Moluccas. The tree attains a height of 20 to 30 feet and greatly resembles our pear tree. The fruit, which is singularly beautiful, is pear-shaped, about the size of an apricot. As it ripens, the pulp, which is nearly half an inch thick, and

of a whitish colour, opens and displays the nutmeg in its black and shining shell, encircled by a network of mace.

The tree begins to bear when ten years old, and goes on improving during the space of a century. The fruit is gathered two or three times a year. Three sorts of nutmegs are distinguished, namely, the male or barren, the royal, and the queen. The last, which are small and round, are preferred to the others, which are large and oval.

In 1830 the duty on nutmegs was 2s. 6d. per lb. on British grown, and 3s. 6d. on foreign, and the consumption was 121,260 lbs., which had increased in 1837 to 134,115 lbs. In 1836 wild nutmegs were admitted at 1s. duty. In 1846 the rates for British and foreign were equalized to 2s. 6d., and for wild lowered to 3d. per lb. In 1847, a distinction was made between wild in the shell and wild "not in the shell," the former being charged 3d. and the latter 5d. per lb. The home consumption in 1859 was 265,783 lbs. The duty on all spices has long since been abolished.

In 1840 the imports were 113,193 lbs.; in 1850, 315,126 lbs.; in 1860, 532,208 lbs.; and in 1870, nearly the same.

Nutmegs are not now specifically named in the Board of Trade returns.

The imports into the London market of late years have been as follows, in bales :—

Year.	Nutmegs.	Mace.
1878	2,470	515
1879	1,870	685
1880	2,090	485
1881	2,130	545
1882	1,910	660
1883	2,600	310
1884	3,780	520
1885	4,015	755
1886	2,890	920

About two-thirds of these are re-exported.

The nutmeg is propagated from fresh seeds (nutmegs) and these vary greatly in size and shape, just as apples and pears do raised from seeds. There can hardly be a more profitable crop than the nutmeg at present prices. The annual yield of a good tree of sixteen or eighteen years' growth, and covering about 600 square feet surface, is about 10 lbs, which, at an average of 2s. per lb., gives a value of produce per acre, per annum, of over £70, exclusive of the yield of mace, 1 lb. each tree, which at 4s. is equal to £10 more. The fruit of the nutmeg takes nine months to mature.

The Banda islands, where nutmeg culture is carried on by the Dutch, are Great Banda or Lonthoir, Neira and Ay.

The shipments of nutmegs from Banda in 1879 were to :—

Holland	1,014 piculs.
Singapore	3,196 "
Java	6,670 "
Mucat, say	157 "
	11,037 piculs.

The following shows the average annual export of spices from the Dutch Settlement in the East, in kilogrammes :—

—	1875-79.	1880-84.	1885.	1886.
Nutmegs	425,000	280,000	160,000	42,000
Mace	203,000	87,000	10,000	8,130
Cinnamon	36,000	71,000	4,800	10,000
Cloves	150,000	45,000	42,000	37,000
Cubebs	..	178,000	81,200	127,000

The nutmegs and mace are shipped from Banda, and the cloves from Amboyna. The decrease shown is caused by the direct shipment from the free ports of the Moluccas and Macassar, to Singapore and Holland. The cinnamon is produced in Flores and Timor, and the cubebs in Java.

The nutmegs are classed into medium, inferior and broken nuts, and the mace into good and chips. As the consumption would seem to be increasing, and the production does not keep pace, the value is likely to rise, although the price has doubled of late. The total exports from Netherlands-India have been as follows, in kilogrammes :—

Year.	Nutmegs.	Mace.
1875	1,283,848	700,974
1880	1,451,540	267,881
1885	1,481,248	277,800

The shipments on private account, exclusive of government shipments, from Java and Madura were, in kilogrammes :—

Year.	Nutmegs.	Mace.	Year.	Nutmegs.	Mace.
1876	425,000	258,000	1881	1,481,000	325,000
1877	1,609,000	408,000	1882	1,232,000	215,000
1878	448,000	341,000	1883	1,057,000	229,000
1879	1,423,000	269,000	1884	1,173,000	284,000
1880	1,351,000	268,000	1885	1,385,000	276,000

The direct imports into Holland were as follows of the different spices, in kilogrammes :—

Year.	Nutmegs.	Mace.	Pepper.	Stock on 31st December.		
				Nutmegs.	Mace.	Pepper.
1878	431,500	112,500	705,000	26,500	7,500	40,600
1879	440,900	123,400	1,372,800	76,300	23,000	10,000
1880	369,600	126,100	420,000	74,000	22,800	..
1881	387,300	110,700	371,300	33,700	20,600	40,000
1882	557,200	150,300	524,700	34,100	22,600	250,800
1883	541,600	159,200	272,300	48,200	31,300	27,200
1884	503,900	162,900	131,400	32,500	18,200	15,300
1885	545,200	145,500	108,700	47,600	22,900	13,500
1886	519,000	93,600	88,300	34,300	4,600	9,000
1887	745,200	160,500	116,400	134,800	22,200	27,000

The British production of nutmegs in the Straits Settlements thirty years ago exceeded the Dutch crop, the total yield of the Bandas in 1855 being but 4032 piculs of nutmegs and 1000 of mace, whilst Pinang alone in that year shipped 4624 piculs of nutmegs and 1340 piculs of mace, and in 1860 exported 6421 piculs of nutmegs and 2094 of mace.

For many years the Straits Settlements were famed for the cultivation of the nutmeg, but of late years the cultivation has been pronounced a failure. In Ceylon the tree is now largely grown.

There were, in 1860, 14,502 acres under culture with spices of all kinds, namely, 13,153 in Pinang, and 1349 in Province Wellesley. Pinang nutmegs are always shipped in the natural state, and not limed.

Limed nutmegs are preferred in some countries. The lime is said to preserve the seeds from insects, but it injures the flavour. The Chinese prefer to import their nutmegs in the *testa* or shell, as they keep good for a great length of time.

There are imported into India from the Straits Settlements about 500,000 lbs. of nutmegs, the imports having been as follows :—

Lbs.				Lbs.			
1881-82	..	..	379,996	1884-85	..	..	515,470
1882-83	..	..	457,569	1885-86	..	..	521,411
1883-84	..	..	461,486				

Jamaica.—The cultivation of nutmegs is being continued on a small scale in this island. The tree, however, is so delicate at high elevations (that is above 600 or 800 feet) that it may be said to be entirely a lowland plant. It requires a warm, moist climate (very similar to cacao), and a deep, rich, alluvial soil, in a sheltered position. It is useless to attempt to grow nutmeg trees on a clayey or stony subsoil, or at any elevation above those already mentioned. Consignments of very fine, selected, large, and heavy nutmeg seeds have been imported from Grenada for planting, many

of these running from sixty to seventy to the pound, while ordinary Jamaica nutmegs run one hundred to one hundred and ten to the pound.

The cultivation of nutmegs is much in favour in Jamaica just now. A fine nutmeg tree there is stated to have had upwards of 4000 unusually large fruit upon it. The value, calculating ninety nuts to the pound, would be 44 lbs., worth at least 3s., or in all £6 12s.

The shape of the nutmeg varies a good deal, being spherical, oblong and egg-shaped, but the nearer they approach sphericity of figure the more highly are they prized. Those of good quality ought to be nearly round, and the largest and finest weigh on the average about a quarter of an ounce each. They should have an agreeable flavour, but rather bitter, and when pierced exude an oily juice.

Nutmegs are valued a good deal according to size, the largest being the best; thus, those of sixty-eight to the pound will fetch 4s. 8d.; while very small, one hundred and twenty to the pound, will be worth but only half that price.

It was at one time thought, for a few years, that the culture would receive a great development in French Guiana, but at last, either from want of proper care, or public infatuation giving way to complete indifference, the nutmeg plantations were gradually given up. Notwithstanding repeated trials in various colonies in the Indian Ocean, West Indies, and America, the nutmeg does not seem to thrive well, and succeeds best in the localities of the Indian Archipelago.

A fraud is often practised in disguising worm-eaten nuts by filling up the holes with mastic. They are also often first deprived of their essential oil by distillation, or steeping in alcohol. Nutmegs yield when distilled with water a volatile or essential oil of nutmegs, in the proportion of about $2\frac{1}{4}$ per cent., and make an oil of nearly similar properties. A concrete oil, known as nutmeg butter, is also imported from the Moluccas; it is prepared by heating nutmegs and afterwards submitting them to pressure. The *Myristica sebifera*, of South America, also yields an oil by expression.

Wild nutmegs of a longer shape are the produce of *Myristica fatua*, or *tomentosa*, and are often imported. Lieut. Cameron states that in his explorations in Central Africa he met with large groves of wild nutmeg trees. A wild nutmeg is also yielded by a Brazilian tree, *Cryptocarya moschata*. A false nutmeg, called in Guiana the Ackawa nutmeg, is the fruit of *Acrodictidium Camara*. Another kind has occasionally been imported on the Continent from Madagascar and Bourbon under the name of clove nutmegs, or raven-sara nuts; they are the produce of *Agathophyllum aromaticum*.

The seeds of *Monodora myristica*, Gaert., are known as calabash nutmegs, and possess the properties, and in some degree the flavour of nutmegs.

There are several other kinds of nutmegs derived from different

species of *Myristica*, which are in use in various parts of the world, but as they are much inferior in their qualities, and are not found in commerce, it is unnecessary to describe them here.

MACE is the reticulated scarlet arillus enveloping the thin, dark brown, glossy, oval shell which covers the nutmeg. When dry, the mace becomes yellow, brown and brittle. In preparing it, it is said to be first steeped in a weak salt solution, which renders it supple and preserves the aromatic principle.

In 1830, the duty on mace was higher than on nutmegs, being 3s. 6d. per lb. on British produce, and 4s. 6d. on foreign; the home consumption then was 12,600 lbs. In 1835, it had increased to 18,835 lbs. The duty was then fixed at 2s. 6d. for all descriptions, and in 1852 the consumption was 21,485 lbs. In 1853, the duty was lowered to 1s. per lb., and the consumption had increased in 1859 to 34,714 lbs.

The present production and consumption of nutmegs and mace may be estimated approximately from the figures given in previous tables.

Nutmegs and mace are employed chiefly as condiments for ordinary purposes, for which they are admirably suited by their agreeable taste and stimulating properties. As remedial agents they owe their activity to the volatile oil which they contain, and when administered in moderate quantities, produce the usual effect of the other spices. Their use requires caution in those subject to apoplexy and other cerebral affections, as they possess narcotic properties. Taken in small quantities these spices assist digestion, dispel flatulency, strengthen the viscera, and stop dysentery.

CASSIA AND OTHER SPICE BARKS.—Many of the trees of the Laurel family, to which the Cinnamon and Cassia belong, contain an aromatic principle, which resides in many parts, such as the bark, leaves, and fruit. Of this we have instances in the berries and leaves of the bay (*Laurus nobilis*), the latter being used for flavouring custards, puddings, &c. Figs imported into this country are also packed in bay leaves.

Laurel leaves in Greece are more aromatic than in other localities. It seems as if in warmer climates the aromatic principles of plants are more profusely developed, like the bitter and astringent principles in the colder regions. In America the bark and wood of *Sassafras officinale* have a pleasant aromatic odour, which leads to a considerable commerce. In the United States the essential oil obtained from it is used to give a pleasant flavour to effervescing drinks, tobacco, and toilet soaps. The bark of a Brazilian tree, *Mespilodaphne pretiosa*, resembles the true sassafras in odour. There is a thick sassafras bark produced in Burma, Martaban, and other parts of India. An eastern sassafras is obtained in Sumatra from *Sassafras Parthenoxylon*, and in Nepal from *S. glanduliferum*; while the bark of *Benzoin odoriferum* of North America is also highly aromatic. The bark of *Atherospermum moschatum* of Tasmania is pleasantly aromatic. The aromatic Malambo bark

(*Croton Malambo*), of Central America, is said to be used in the United States for adulterating spices.

The spice bush (*Oreodaphne Californica*), a lofty tree, has leaves which are pungently aromatic, and the spice wood (*Lindera Benzoin*) found in Western Virginia has a highly aromatic wood. Sassafras nuts, the large separate cotyledons of two Lauraceous trees of Brazil, are also occasionally met with in commerce and used for flavouring. Another member of the Laurel family, *Daphnidium Cubeba* of Nees von Esenbeck, has berries which have an agreeable warm aromatic flavour, and are used as spice by the Chinese.

In ancient Italy the berries and flower buds of the myrtle were used as a kind of spice. The modern Tuscans and the people of Syria and Palestine still frequently substitute these for pepper or flavouring.

CASSIA BARK.—Messrs. Hanbury and Fluckiger have furnished more ample details respecting this bark than had previously been published, and they state that various species of *Cinnamomum* occurring in the warm countries of Asia from India eastward, afford what is termed in commerce cassia bark. The trees are extremely variable in foliage, inflorescence, and aromatic properties, and the distinctness of several of the species laid down even in recent works is still uncertain. At present, neither botanists, pharmacologists, or spice dealers are able to point out characteristics by which to distinguish the barks of this group, or even to give definite names to those found in our warehouses.

The bark which bears *par excellence* the name of Cassia, or Cassia lignea, and which is distinguished on the Continent as Chinese cinnamon, is a production of the provinces of Kwang-se and the Kweichan in Southern China. Cassia lignea is also produced in the Khasya mountains in Eastern Bengal, whence it is brought down to Calcutta for shipment. In this region there are three species of cinnamon, growing at 1000 to 4000 feet above the sea-level, and all have bark with the flavour of cinnamon, more or less pure; they are *Cinnamomum obtusifolium*, Nees; *C. pauciflorum*, Nees; and *C. Tamala*, Nees. *C. iners*, Reinw., a very valuable species occurring in Continental India, Ceylon, Tavoy, Java, Sumatra, and other islands of the Indian Archipelago, and possibly, in the opinion of Thwaites, a mere variety of *C. Zeylanicum*, but, according to Meissner, well distinguished by its paler, thinner leaves, its nervation, and the character of its aroma, would appear to yield the cassia bark or wild cinnamon of Southern India. *C. Tamala*, Fr. Nees et Eberm, which, besides growing in Khasya, is found in the contiguous regions of Silhet, Sikkim, Nepal, and Kumaon, and even reaches Australia, probably affords some cassia bark in Northern India. Large quantities of a thick sort of cassia have at times been imported from Singapore and Batavia, much of which is produced in Sumatra. In the absence of any very reliable information as to its botanical sources, we may suggest as mother plants *C. cassia*, Bl., and *C. Burmanni*, Bl., var. *a. Chinense*, both stated by Teijsman and Binnendijk to be cultivated in Java. The latter

species, growing also in the Philippines, probably affords the cassia bark which is shipped from Manila (*Pharmacographia*).

The exports of Cassia bark from Java and Madura were as follows:—

	Kilos.		Kilos.
1876	5,798	1880	14,995
1877	56,100	1881	208,841
1878	76,097	1882	53,813
1879	16,578	1883	38,184

This is possibly the produce of *Cinnamomum Burmanni*, Blume, *C. kiamis*, of Nees, known as Massoi bark.

The bark is stripped off by running a knife along the branch on both sides, and then gradually loosening it, after it is taken off it is suffered to lie for twenty-four hours, during which it undergoes a kind of fermentation, and the epidermis is easily scraped off. The bark soon dries into the quilled shape in which it is brought to market. In China it is used to flavour medicine, and for making incense. The extreme tender ends of the branches of the tree are also used as a spice.

CASSIA LIGNEA EXPORTED FROM CHINA, in PICULS.

1874	54,502	1880	38,784
1875	53,047	1881	57,456
1876	38,090	1882	58,170
1877	52,417	1883	76,196
1878	72,171	1884	13,822
1879	99,633		

About 14,000 cwts. are annually imported into India from China.

There is but a small consumption of it in this country—not more than about 40,000 lbs. a year on the average. The bulk of the receipts go to the Continent, true cinnamon bark being preferred here. From 42,000 to 55,000 cases of Cassia bark arrive yearly in London.

The imports of spices of all kinds from China, including Hong Kong, into this country have been as follows (the bulk of this is cassia bark and cassia buds):—

Year.	Quantity.	Value.
	lbs.	£
1870	888,913	32,695
1875	1,206,598	35,608
1880	7,288,983	145,976
1886	3,937,112	43,520

CASSIA BUDS are the immature fruits gathered and dried of several species of Cinnamon, chiefly the Chinese Cassia lignea. They are used in confectionery, having the flavour and pungency of cassia.

In Southern India the more matured fruits of one of the

varieties of *Cinnamomum iners*, Reinw., are collected for use, but are very inferior to the Chinese cassia buds.

When gathered young, the receptacles completely envelope the embryo seed, which progressively protrudes, but continues firmly embraced by the receptacle. The buds are of various sizes, having the appearance of nails with roundish heads. If completely dried the receptacle is nearly black.

CINNAMON.—The cinnamon of commerce is the aromatic bark of a species of laurel, *Cinnamomum Zeylanicum*, Breyne. Its fruit is a small berry in the form of an olive, with a kernel. The bark is composed of thin layers, which are separate; these, cut in lengths, are exposed in the sun, and curl up in drying. Good cinnamon should be fine, thin, brittle, of a yellowish brown, and aromatic. It is one of the delicate spices of the table, and is also used in medicine.

In the 'Feuille de la Guyane' for 1820, of Guisan, page 339, it is represented as a very hardy plant, growing well in all situations, soils, and aspects, on the summits of mountains, on the borders of streams which wash its roots; in alluvial soils, thoroughly or badly drained, it is stated to succeed well. This differs, however, from the opinions entertained in Ceylon, where cinnamon of a superior quality is restricted to sandy soils. Leblond remarks that every part of the tree is important, and can be applied to some useful purpose, the wood, leaves, fruit, and bark. The roots even yield, by distillation, a camphor of equal quality to that ordinarily used in medicine. The old trunks furnish resinous knots which have the odour of rosewood, and can be advantageously employed for furniture; the leaves furnish an oil appreciated by perfumers; a distilled water from the flowers, besides the soft and pleasant odour, sweetens the worst breath, animates the spirits, and diffuses its pleasant perfume wherever it is used.

The cinnamon is raised most readily from seeds, although the fine kinds are propagated in Ceylon by layers, and they differ in the degree of aromatic principle or flavour just as much as the nutmeg varies in respect of size, but the quality of the seedlings can always be ascertained in the seedling bud by tasting the leaves.

The roots of the cinnamon tree are branchy and ligneous; the bark of these roots has the pungent smell of camphor, with the delicious odour of cinnamon, and yields camphor by distillation. The wood of the tree is light, fibrous, and inodorous. The trunk is from 12 to 18 inches in diameter, rising to the height of from 20 to 30 feet; it grows irregular and knotty; the external bark is thick, rough, and scabrous, and of an ash colour; the inner bark is reddish. The bark of the young shoot is often speckled with dark-green and light-orange colours. The branches are thick and spreading, and shoot forth horizontally or inclining downwards; they are covered with numerous oblong leaves growing in pairs opposite to each other. When first developed, these leaves are of a bright red hue, then of a pale yellow, and when arrived

at maturity of a dark olive colour. At full growth they are from 6 to 9 inches long, and from 2 to 3 inches broad. The upper surface is smooth and shining, and of a darker green than the under side. The petiole has the odour and taste of cinnamon. The plants bloom in January and February, and the seed ripens in June, July, and August. Many white flowers grow on one peduncle. Their smell, though not strong, is exceedingly pleasant, resembling a mixture of the rose and lilac. The fruit is an oval berry, larger than black currants, and adheres in the manner of an acorn to the receptacle, which is thick, green, and hexangular. The leaves when full grown emit a strong aromatic odour on being bruised, and have the pungent taste of cloves.

The prepared bark of this tree is the cinnamon of commerce. Diversities in the quality of cinnamon do not appear to arise from any varieties of the plant, but from care and skill in the preparation, the soil and temperature of the country, the age and health of the plant. It is rarely found worth collecting except in the southern and western aspects of Ceylon. Beyond certain limits the bark is never of a good quality, as it is powerfully affected by local circumstances.

The Karuwa of the Malabar coast has been considered by many botanists as identical with the *Laurus Cassia*, but it is said that specific difference can be discovered between the cinnamon tree of Ceylon and the karuwa. The prepared bark of the karuwa is, according to good authority, inferior to the best Ceylon cinnamon. It is, however, allowed to be superior to the produce of the cinnamon tree which is found on the northern and eastern part of the island. Linnaeus, deceived by the name of *Laurus Cassia*, was misled, and ascribes qualities to that tree which it does not possess.

The cinnamon plant delights in a silicious soil, with an admixture of vegetable mould, in which only it produces the sweet taste, aromatic smell, and the pale brown or russet colour which renders it so valuable as an article of commerce and useful as spice, for it has generally happened that plants, even of the genuine kind, when they grow in valleys or marshy ground, or on land subject to inundations, lose their characteristic properties; two-ninths of the plants growing in Batticolea and Chilaw, allowed to be of the genuine kind, are deficient in smell and taste, and consequently less useful or valuable; and the cinnamon grown in the valleys of Moronea Corle, the soil of which is marshy, yields a bark of inferior quality. Again, the plants which are raised in Bombay, from seeds and seedlings sent thither at an early period of the British rule in that island, although they grew luxuriantly, produced bark of an inferior quality, which was not valued as an article of commerce.

Besides the inferiority in smell, taste, and colour, which invariably marks plants grown in any other than a silicious soil, a disadvantage of no little importance to the grower has been observed to follow. Whilst the stumps of plants grown in silicious soil shoot forth rapidly, and are fit to be peeled a second time

within a period of but four or five years, and produce bark superior in quality to that peeled at first, those grown on a hilly or marshy soil require not less than six years before they can undergo a second peeling, and yield bark less in quantity and inferior in quality to that peeled at first.

When the ground is prepared for planting cinnamon, the low brushwood and young trees are cut down, but lofty trees are allowed to remain at intervals, as it is found that the tender plants thrive better under shade than when exposed to the direct rays of the sun. The planting usually takes place when the seeds are ripe; for this purpose a line is stretched across the ground, and, guided by it, the planter turns up about a foot square of earth at intervals of 6 or 7 feet. The brushwood and branches having been previously burnt, their ashes are spread upon the newly dug spots, and into each of them four or five cinnamon berries are sown in holes made with a dibble; they are then covered with earth, and branches of trees are laid over the parts to prevent the earth from becoming parched, and to protect the young shoots as soon as they come forth. This takes place in about fifteen or twenty days; sometimes the berries are sown in nurseries, and the young plants are transplanted in the months of October and November. In favourable situations shoots attain the height of 5 or 6 feet in about six or seven years, and a healthy bush will then afford two or three shoots for peeling. In a good soil, every second year from four to seven shoots may be cut from one tree; thriving shoots of four years' growth are sometimes fit for cutting. As four or five seeds are usually sown in one spot, and in most seasons the greater part germinate, the plants grow in clusters not unlike a hazel bush. If the season be unusually dry, many of the seeds fail, while the want of moisture is often fatal to the young shoots, so that it is sometimes necessary to plant a piece of ground several times successively. A plantation of cinnamon, even on good ground, cannot be expected to make much return until after the lapse of eight or nine years. This plant is sometimes propagated from shoots cut from large trees, by layers, or, lastly, by transplanting large stumps.

The method of culture by seeds is considered the least advantageous, as the trees are longer before they arrive at perfection.

If cultivated from shoots, the sprouts must be continually watered, or they will not thrive. Those selected for the purpose should be very young, not having more than three leaves; if older they die.

The third method, by layers, is recommended by Dr. Wight, since the numerous side branches which issue from the bottom of the trunk always furnish a plentiful supply well adapted for layering. The transplanting of the old roots is a plan of modern adoption, and the practice is much approved, since they yield shoots of the usual size twelve months after they have been placed in the ground. Great care is, however, necessary in their removal, for should any of the rootlets, even of one-tenth of an inch diameter, receive injury, the whole root will certainly perish.

Thunberg mentions a fifth method of cultivation, or rather a manner of obtaining cinnamon of superior quality. When the tree is cut down and a fire kindled on the spot to consume the stumps, the roots afterwards throw out a number of long straight shoots, which yield incomparably fine cinnamon. From these are cut the cinnamon walking-sticks, which in appearance resemble those of the hazel tree, and retain the taste and smell of cinnamon. They have no scent, however, unless when the bark is rubbed.

The peeling process commences early in May, and continues until late in October. When a Chilaw perceives a shoot of proper growth, he strikes an instrument which resembles a small bill-hook obliquely into the shoot. He then gently opens the gash to discover whether the bark separates freely from the wood; should this not be the case, he leaves the sucker for a future time. Some shoots never arrive at a fit state for decortication. Plants of several years' growth sometimes bear numerous marks of annual experiments made for the purpose of ascertaining whether the bark was in a favourable situation for removal.

The shoots which are cut are usually from a half to three-quarters of an inch in diameter, and from three to five feet long. Some travellers in former times asserted that the cinnamon was peeled from the tree while standing, and that nature provided the decorticated plant with a new bark. It is said that the experiment has been recently tried on several plants, all of which died in consequence. The shoots being cut are tied in bundles, and carried to sheds appropriated to the preparation of the cinnamon.

Being cleared of small shoots and leaves, two longitudinal slits are made in the bark, which is gradually loosened with the convex side of the knife, and then usually half the circumference of the bark comes off in one entire slip. When the bark adheres firmly to the wood, it is strongly rubbed with the handle of the peeling-knife until it is disengaged and stripped off. The sections of the bark thus obtained are carefully put one into the other, the outer side of one piece being placed in contact with the inner side of another; they are then collected into bundles, and firmly pressed or bound together.

In this state the bark is allowed to remain for twenty-four hours, or sometimes for a longer period, by which means a degree of fermentation is induced that facilitates the subsequent operations of removing the cuticle. After being subjected to this treatment, the interior side of each section of bark is placed on a convex piece of wood, and the epidermis, together with the greenish pulpy matter, immediately under it, is carefully scraped off with a curved knife. This is an operation requiring some nicety, for if any of the outer bark be allowed to remain, it gives an unpleasant bitterness to the cinnamon. In a few hours after the removal of the cuticle, the pieces are put one into the other, the bark dries, contracts, and gradually acquires the appearance of a quill or pipe, the whole forming a congeries of quills more than a foot in length. During the first day the cinnamon is suspended under shelter upon open flat forms; on the second day it is placed on wickerwork

shelves, and exposed to the sun. When sufficiently dry it is made up into bundles of about 30 lbs. weight each; previous to preparing for shipment, they are subjected to the process of assortment.

The bark of large shoots or thick branches of trees produces coarse cinnamon. Occasionally the external pellicle of this kind is scraped off, which thins the cinnamon and improves its colour. It is, however, even then thicker and of a darker colour than that of good quality, while it is of a very inferior flavour, and is disagreeably pungent. This sort is always rejected by the Inspectors as unfit to be exported to Europe. The bark of very young and succulent shoots is likewise of an inferior quality, and is of no commercial value. It is very thin, and of a light straw colour, having little flavour, and that evanescent. Shoots exposed during growth to the direct rays of the sun, have their bark more acrid and spicy than the bark of those which grow under a shade. A marshy soil rarely produces good cinnamon, its texture under the circumstances being cross-grained and spongy, while it possesses but little aroma. It is hardly possible to discover the cause which produces the varieties in the quality of the bark, since shoots from the same tree are found to yield cinnamon of very different qualities.

The best Ceylon cinnamon is thin, smooth, and of a light yellow colour; it admits of a considerable degree of pressure, and bends before it breaks. The fracture is thin and splintery; it has an agreeable warm aromatic flavour, with a slight degree of sweetness. When masticated the pieces become soft, and seem to melt in the mouth.

From cinnamon which has been rejected for shipment an essential oil is usually extracted. The best oil of cinnamon sinks in water, but when inferior it is of smaller specific gravity. A very large quantity of bark is required for obtaining only a small portion of oil: it is reckoned that 80 lbs. of newly-prepared cinnamon yield about 6½ oz. of heavy oil, and 2½ oz. of light oil.

There are 37,000 acres under cinnamon in Ceylon. The produce is 1,680,568 lbs. of bark and 600,000 lbs. of chips. The value of the home consumption in England and export is about £50,000. Prices have, however, fallen 50 per cent. in the last six or seven years.

The total exports of cinnamon from Ceylon have been as follows:—

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	lbs.	£		lbs.	£
1850	644,857	64,487	1880	1,566,820	99,757
1860	675,156	33,758	1887	1,109,973	44,436
1870	2,071,679	103,584	1888	1,351,990	42,845

In Java several species of wild cinnamon are met with, as *C. kiamis* and *C. sintok*, the bark of which is generally employed

to prepare an aromatic oil. It is not cultivated to any extent, being chiefly restricted to the residency of Krawang. Mention is made of it under cassia bark.

In 1885 the Chinese plant (*Cinnamomum aromatica*) was introduced into the residencies of Bantam, Banjoemas, Krawang, and Preanger, in Java, under the name of cassia.

VANILLA.—One of the most profitable and least troublesome cultures of humid tropical climates is certainly that of the Vanilla orchid, of which there are several species, as the true vanilla (*Vanilla planifolia*, And., *V. sativa*, Scheede), *V. aromatica*; the wild or simaroma (*V. sylvestris*), a variety of *V. planifolia*, and the pompona (*V. Pompona*). This orchid is indigenous to the hot regions of Eastern Mexico, but grows from thence to Peru, on the American continent, and has been diffused by cultivation through the West Indies, the Indian and Pacific Islands. The plant, which is rather fleshy, and has large green inodorous flowers, grows in moist and shady forests, climbing the trees by means of its aerial roots.

The annual consumption of vanilla is about 5000 kilos. in the United States, and 30,000 kilos. in France. Spain and England also use some quantity. The manufacture of an artificial vanilla was commenced, some ten years ago, from coniferin, a glucoside occurring in the cambial secretion of firs, but this has not made much progress.

Mexico.—The finest vanilla is the Mexican; but that of Mauritius is now considered equally good. The chief seats of production are the coast regions of the State of Vera Cruz, the centre of the culture being Jicaltepec, in the vicinity of Nantla. It is likewise obtained on the western declivity of the Cordilleras, in the State of Oaxaca, and in lesser quantity in those of Tabasco, Cheapas, and Yucatan. The eastern parts of Mexico exported in 1864, by way of Vera Cruz and Tampico, about 44,000 lbs. of vanilla, chiefly to Bordeaux. Since then the production seems to have much declined. Papantia, Vera Cruz, produces excellent vanilla. The value of the export of vanilla from Mexico in 1873 was 473,038 dollars.

In 1887 vanilla to the value of £17,536 was exported from Vera Cruz, of which £13,914 went to the United States, £3,153 to Germany, and £289 to France.

Vanilla flourishes chiefly in two places in Mexico, Papantia, in the State of Vera Cruz, and Misantia; but the first place is the most important. The orchid is found wild in the forests around Papantia, clinging to the trees and bushes for support. When the pods ripen, in November and December, the natives go out into the forests to gather them. All kinds are put into old sacks together, and brought into Papantia to market. Here there are a number of buyers, Spaniards or Americans. The pods or beans are purchased by middlemen, at the rate of 40s. or 50s. per 1000, taken and they are put up by the natives. One thousand good-sized green vanilla beans will weigh 60 lbs.; the same, when cured, about

10 lbs. The first fine morning planks are arranged and covered with quilts or blankets, on which the beans are laid after being divested of their stems. The sweating process, as it is called, then takes place, and has to be repeated seven times before all the water has evaporated. Then the beans are heated slightly, and placed on shelves to dry and air. After this they are assorted in lots of fifty beans, graded according to length. In fine weather the curing process takes three weeks, but such weather rarely prevails, and the curing sometimes takes from four to five months. In 1888 the beans sold for 58s. per 100, which was about a pound weight; but owing to a heavy crop in 1886, and the growing competition in the business, the best beans only bring now 50s. per lb. or 100, and the inferior from 30s. to 42s. The principal markets for vanilla beans in the United States are New York, St. Louis, and Chicago. In 1887, from the vicinity of Papantia alone, 60,000,000 beans were exported.

The bundles are packed in tin cases, which often hold from 2000 to 3000. These cases are lined with tin-foil, and a ticket placed on the lid, specifying their quality, size, and quantity. Some five or six of these tin cases are put into a neatly-made cedar chest, which is sometimes lined with zinc and hermetically sealed, so as to prevent moisture from getting to the vanilla in transport, which would ruin it. These cedar cases are then sewed in mats, and covered with a coarse bagging, to avoid the danger in transport on mules. In this manner all the Mexican vanilla goes to the places of sale in Europe and the United States.

The culture is very simple. Shoots about 3 feet long having been fastened to trees on the approach of the rainy season, and scarcely touching the ground, soon strike roots attached to the bark, and form plants which commence to fruit in three years, and remain productive for thirty or forty. The plantations are cleared once a year from weeds and undergrowth.

Several varieties are recognised by the growers. One, the "vanille de cochon," is so called from emitting an offensive smell whilst drying. The harvest begins about December, when the fruit becomes yellowish-green, as it is not allowed to arrive at maturity. There are two ways of preparing it for the market. In one method the fruit is allowed to dry until the pod loses its green colour. Straw mats covered with woollen blankets are spread on the ground, and when these are warmed through, the fruits are spread on them and exposed to the sun. After a time they are wrapped in blankets, and placed in boxes covered with cloth, after which they are again exposed. In about twelve hours the fruits should become of a coffee colour, but if they do not, the process is repeated. After about two months' daily exposure they are tied up in bundles of fifty, and packed in tin boxes. Five qualities of vanilla pods are known: the best is the *primeira*, the pods of which are 24 centimetres long, and proportionally thick. The second quality is called *chica prima*, the pods are shorter, and two count as one; the third, *sacate*, and the fourth, *vesacate*, are still smaller, four of the latter being reckoned for one. The fifth and

poorest quality is called *basura*. The fruit is very small, spotted, and much cut or broken about.

The following is another method of preparing vanilla for the market: About 12,000 of the pods are strung together by their lower end, as near as possible to the footstalk; "the whole are plunged for an instant into boiling water to blanch them; they are then hung up in the open air and exposed to the sun for a few hours. By some they are wrapped in woollen cloths to sweat. Next day they are lightly smeared with oil by means of a feather or the fingers, and are surrounded with oiled cotton to prevent the valves from opening. As they become dry, on inverting their upper end, they discharge a viscid liquor from it, and they are pressed several times with oiled fingers to promote its flow. The dried pods, like the berries of pepper, change colour under the drying operation, grow brown, wrinkled, soft, and shrink to one-fourth of their original size. In this state they are touched a second time with oil, but very sparingly, because with too much oil they would lose some of their delicious perfume."

In Guatemala the Indians of Vera Paz collect a good deal of vanilla growing wild in the woods along the banks of the river Polochia, and in the forests to the north-west of Coban, and this orchid is also found growing on the coast of Suchitepequez.

It appears somewhat remarkable that the cultivation of vanilla in the British West Indies has not been largely undertaken, as it would be attended with little difficulty, and might be made a source of much profit to the inhabitants. But even in Caraccas and Guiana, where the plant grows profusely in a wild state, it is almost entirely neglected. It has been attempted in Jamaica.

Brazil.—Vanilla is very badly prepared in Brazil; in fact, no attention is given to the culture—the wild pods are merely collected in the woods as they ripen. These vary in length in different districts. The Brazilian pods are in general much larger than those grown in Mexico. Those of the province of Sergipe are 8 to 10 inches long by 6 to 12 lines broad; those of Minaes are 6 to 9 inches long by 4 to 6 lines broad. The ordinary pods found in British commerce are from 3 to 8 inches long by a third to half an inch wide. The large Pompona pods are known as *vanillons* in France. The name vanilla is a diminutive of the Spanish *vaina*, a pod.

The chief use of vanilla is in flavouring perfumery and confectionery, ices, creams, and especially chocolate. One pod is sufficient to flavour a pound and a half of chocolate, being ground with sugar for that purpose. The fragrance is said to act upon the system as an aromatic stimulant, exhilarating the mind, and increasing the energy of the animal system. It is occasionally employed on the Continent in cases of hysteria, and is used by the Spanish physicians in America as an antidote to poison and to the bite of venomous animals, as well as in other cases. A liquid used in Peru, where it is known as *Baume de vanille*, exudes from the open pods at perfect maturity. The fruits in time become covered with an efflorescence of fine needle-like crystals, which possess

properties similar to those of benzoic acid; when viewed through a microscope with polarized light, they are very beautiful objects.

In the 'Medical Flora,' it is stated that vanilla exercises a powerful action on the animal economy, and justifies the attributes of tonic, stimulant, and comforting, which are accorded to it. The truly active and strong impression which it makes on the nervous system by its fragrant aroma, and on the stomach when taken internally, is rapidly and sympathetically transmitted to all the organs, the functions of which it more or less accelerates. Hence, when the system is lowered, vanilla facilitates digestion and nutrition, augments the cutaneous transpiration or the secretion of urine, and acts as a tonic in various other ways. It is recommended in cases of dyspepsia, melancholy, hypochondria, and chlorosis, where the digestive functions are sluggish or torpid.

It is much employed by the Spaniards in South America to cure various maladies, being reckoned stimulant and stomachic.

Besides the large consumption of vanilla as a flavouring essence, it is also used to a small extent in scenting tobacco, snuff, and cigars, and as a perfume; and more recently a new demand for vanilla has arisen, especially in Germany, the pod having been found to yield a fine brown colour.

The quantitative determination of vanillin in vanilla shows that the percentage of this aromatic principle varies between 1.5 and 2.75 per cent. Mexican vanilla of prime quality was found to contain 1.69 per cent.; Bourbon vanilla, 1.91 and 2.48 per cent.; and Java vanilla, 2.75 per cent. The vanillin in the Bourbon and Java vanillas is associated with an unpleasantly odorous volatile oil, for which reason the Mexican variety, notwithstanding its inferiority in the quantity of the aromatic principle, is preferred, and commands a better price.

The pods as received in Europe are made up in packets containing fifty each, and should be fresh, unctuous, and very aromatic. The gathering commences towards the end of September. The pods, after they have been plunged for a moment in a vessel of boiling water, to blanch them, are then hung up in an airy place. The desiccation is a difficult operation, and must proceed slowly. The pods are frequently oiled with mahogany-oil, to render them supple and preserve them from insects; they are also tied up with cotton threads, to keep them from opening. These are delicate operations, and the rareness of complete success explains the high price of vanilla of the first quality. As soon as the pods are ready, no time is lost in wrapping them in oiled paper and packing them in tin boxes; exposed to air, they would speedily lose their aroma. . . . The vanilla, when covered with the brilliant silvery efflorescence, caused by the essential salt contained in the fruit working its way out, is called *vanille givrée*, and is preferred to all others. This efflorescence sometimes makes its appearance on a pod two or three years after its preparation for market: kept in a hermetically closed box, it will retain its perfume for many years. Vanilla is despatched in tin boxes, weighing generally from 17 to 18 kilo-

grammes (or about 37 to 39 lbs.). The buyer should assure himself that the packets in the box are entire, and that the pods are of the same length. Frauds are often practised in the retail sale of vanilla. Some unscrupulous persons impart a perfume by means of oil of benzoin to old dried-up pods, soak them in a mixture of oil of sweet almonds and balm of Peru to restore their softness, and dust them with salt to give them the desired crystalline efflorescence.

Guadaloupe.—Some attention has been given to the production in this French island. In 1872, 1496 kilos. were raised; in 1874, 598 kilos., and in 1885, 12,000 kilos.

The culture of vanilla is being much reduced in the French colonies, as at present prices it barely repays the cost of production. At Mayotte there were seven growers and about 40 acres under culture with vanilla, producing, in 1885, 1180 kilos.

At Nossi-bé there were seven growers, and about 100 kilos. produced. At St. Marie, near Madagascar, there were two plantations which produced, in 1885, 10,000 kilos. of vanilla. In the French Pacific Islands there are about 450 acres devoted to vanilla, which produce 2500 kilos. of vanilla.

Reunion.—The introduction of the culture in this island dates from about a quarter of a century ago. In 1861, nearly 40,000 lbs. were exported, amounting in value to about £100,000.

A good deal of attention has been of late given to vanilla production here. In 1874 the produce was 44,000 kilos., valued at £162,000.

The gradual progress made is shown by the following figures:—

Year.	Hectares.	Produce.	Year.	Hectares.	Produce.
		kilos.			kilos.
1866	223	15,494	1874	1,563	43,959
1872	1,562	19,375	1885	2,475	164,357
1873	671	50,695			

The value of the produce in 1885 was £54,400.

The hectare is nearly $1\frac{1}{2}$ English acres, and the kilo. a little more than 2 lbs. avoirdupois.

In Reunion, vanilla is prepared in two ways with boiling water according to local practice, and by drying in a furnace in the Mexican style. Bourbon vanilla is generally shorter and less intense in colour than Mexican, and commands a lower price.

The vanilla of this island is the principal rival and competitor with Mexico. There has been a very great advance in the consumption in France within the last year or two. The imports rose from 200,000 lbs. in 1880 to 260,000 lbs. in 1886.

Unless circumstances arise which are at present unforeseen, and also by reason of the newness of some of the plantations, the colony can produce in two or three years from 160,000 to 170,000 kilos. of vanilla. This cultivation is also extensively carried on in Madagascar and Mauritius, and this extended production has

created a supply too great for the demand, hence prices have declined.

Vanilla is cultivated more particularly by the small proprietors than by the great. Its produce assists a part of the population who are averse to work, and the small extent of whose lands has not allowed them hitherto to think of attempting a cultivation like that of the sugar-cane, maize, manioc, or coffee, which would require the assistance of labourers or field-hands. Provided the soil be fertile, moist, and shaded, it needs but a small space to accommodate thousands of vanilla plants, and the produce being of considerable value, yields to the cultivator a profit which no other plant on the island can give.

For exportation in good condition, vanilla should be packed in tins well soldered, in quantities of about 10 lbs.

Mauritius.—It was from Reunion that the vanilla orchid was carried to Mauritius, and several thousand pounds are shipped annually. A small quantity of that exported is not raised in the island, but is imported produce. Excellent vanilla is grown in the Seychelles, where an acre will yield 250 lbs.

There is a somewhat extensive cultivation of vanilla in Java. The culture on a systematic basis was introduced in 1841 by M. Teysmann, Director of the Botanic Gardens at Buitenzong. He introduced the artificial process of fecundation with beneficial results. In some years 2300 kilos. have been obtained; of later years not one-fourth of this.

The island of Tahiti has 700 acres under vanilla, and produces annually about 5000 lbs. of vanilla. It is mostly shipped to San Francisco, where it sells at 8s. to 10s. 6d. per lb. It cannot compare with Mexican or Mauritius, its pronounced odour of heliotrope rendering it unfit for use in confectionery or chocolate, hence it is applied to perfumery and medicinal purposes.

Among the vegetable odours assimilating somewhat to vanilla are the Faham leaves, of Mauritius, from another orchid, *Angræcum fragrans*, which somewhat resembles the perfume of vanilla and Tonquin beans. The leaves of a few other orchids, such as *Orchis fusca*, dried carefully, also possess the odour of those of the Faham.

PIMENTO OR ALLSPICE.—This spice, of large consumption, is a West Indian product, the fruit of a beautiful lofty evergreen tree, the *Pimenta officinalis*, Lindley, *Myrtus Pimenta*, Linn., *Eugenia Pimenta*, Dec., almost entirely grown in Jamaica. Every attempt to carry the seeds to San Domingo and Cuba, and to propagate it there has failed, and, though the tree is found in Yucatan, the fruit is not exported thence.

The Pimento walks are situated in the mountains on the north side of the island, where the trees grow in hundreds. It is a white-trunked shapely tree, not unlike in form and growth an English apple tree, but with a thicker, richer foliage and dark glistening leaves, aromatic like its fruit, and resembling those of the myrtle, to which family it belongs. The trunk is white, because every year the bark strips. Nature seems to have in-

tended that some useful purpose should be served by the bark, but hitherto it has not been made available commercially. The tree blossoms twice, but only bears once a year. The blossom that holds and sets to fruit appears in April. The tree grows spontaneously, and seems to mock all the labours of man in his endeavours to extend or improve its growth; not one attempt in fifty to propagate the young plants or to raise them from the seeds, in parts of the country where it is not found growing spontaneously, having succeeded. The usual method of forming a new Pimento plantation (in Jamaica it is called a "walk") is nothing more than to appropriate a piece of woodland in the neighbourhood of a plantation already existing, or in a district where the scattered trees are found in a native state, the woods of which being felled, the trees are suffered to remain on the ground till they become rotten and perish. In the course of twelve months after the first season, abundance of young Pimento plants will be found growing vigorously in all parts of the land, being, without doubt, produced from ripe berries scattered there by the birds, while the fallen trees, &c., afford them both shelter and shade. At the end of two years it will be proper to give the land a thorough cleaning, leaving such only of the Pimento trees as have a good appearance; these will then soon form groves, and, except for the first four or five years, require very little subsequent attention. In July and August, soon after the trees are in blossom, the berries become fit for gathering, the fruit not being suffered to ripen on the tree, as the pulp in that state, being moist and glutinous, is difficult to cure, and when dry becomes black and tasteless. It is impossible, however, to prevent some of the ripe berries from mixing with the rest, and, if the proportion of them be great, the price of the commodity is considerably injured. It is gathered by the hand. One labourer on the tree, employed in gathering the small twigs bearing the branches, will give employment to three below (who are generally women and children) in picking the berries, and an industrious picker will fill a bag of 70 lbs. in the day. It is then spread on a terraced floor and exposed to the sun and air for some days, in the course of which it loses its green colour and becomes of a reddish-brown. When perfectly dry the stalks are removed, it is passed through a fanner, bagged, and is ready for shipment. The term sometimes used to denote the in-gathering of the crop is not picking, but "breaking," because, with each cluster of berries, a portion of the branch is broken off, the tree thriving all the better for the spoliation. The returns from a Pimento walk in a favourable season are prodigious. A single tree has been known to yield 150 lbs. of the raw fruit, or 1 cwt. of the dried spice, there being commonly a loss in weight of one-third in curing; but this, like many other of the minor productions, is exceedingly uncertain, and perhaps a very plenteous crop occurs but once in five years.

Before the war with Russia there was a large demand for Pimento in that country for use in spiced bread, but, during the blockade, it was found that a tree growing on the banks of the

Amoor yielded a bark which, when grated, was pungent enough to yield a spice, and the Russian market was thus lost.

The acreage under Pimento seems to vary. In 1871 it was returned at 6902 acres, in 1874 it was only 1392 acres. Between 1830 and 1850 the crops ranged from 3,000,000 lbs. to 5,500,000 lbs.

The crops and shipments of pimento fluctuate with the seasons and according to the price obtainable. This has frequently fallen as low as 1½d. per lb., making it scarcely worth the expense of picking.

Jamaica supplies the world with this spice, which is exported in large quantities from no other country. The pimento tree, which is allied to the myrtle family, grows abundantly on warm limestone hills at elevations of from 1500 to 2500 feet. Beneath the trees cattle and horses are pastured, feeding on the nutritious pimento grass.

The exports from Jamaica were in

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	cwts.	£		cwts.	£
1854	41,179	83,158	1885	87,447	53,867
1874	51,439	36,008	1885-6	61,777	..
1884	110,472	92,796	1886-7	66,000	..

About one-fifth of the total quantity produced is sent to the United States. A large trade is now carried on in young pimento stems for walking sticks and umbrella handles, some 5000 bundles of these are shipped annually, valued at about £3500.

The berry of Allspice is globose, one-seeded, black, rather variable in size, but commonly the size of a pea, from two-tenths to three-tenths of an inch in diameter. All the plant, especially the unripe fruit, abounds in an essential oil (3 to 4 per cent.), which is a powerful irritant, and is often used, like oil of cloves, to allay toothache. The bruised berries are carminative, stimulating the stomach, promoting digestion, and relieving flatulency. The chief use of Pimento is as a culinary spice, for which it is largely employed both in Europe and America. It has an agreeable pungent spicy flavour, much resembling that of cloves, for which, when ground, it is often sold. The berries have a similarity in smell and taste to cloves, juniper berries, cinnamon and pepper, or rather a peculiar mixture of all combined, whence the name of Allspice or Jamaica pepper.

The Mexican spice called "Pimienta do Tabasco," coming from Tampico, is probably the "Piment Tabago" of Guibourt. It is somewhat larger and less aromatic than the Jamaica Allspice, and is believed to be derived from a variety of the Jamaica species (*P. officinalis*). The wild clove tree *Eugenia* (*Pimenta*) *acris*, Wight and Arnott, and *P. Pimento*, Griseb, afford analogous aromatic products, but do not appear much in commerce. A Pimento plantation was tried in Tobago, but it was abandoned for sugar cane.

Oil of Pimento has substantially the same composition as oil of cloves. Pimento is used in tanning, striking with a persalt of iron an inky black, and a patent has recently been taken out in Jamaica for the employment of the leaves as a tanning material.

CLOVES are the dried calyces or flower-buds of the *Eugenia caryophyllata*, *Caryophyllus aromaticus*, Lin.

In British commerce they are chiefly distinguished by their places of growth, and rank in the following order—Penang, Bencoolen, Amboyna, and Zanzibar. There also enter into commerce as secondary products, clove stalks and mother cloves, or the dried unripe fruit. Clove stalks are largely shipped from Zanzibar and Reunion.

This elegant tree grows spontaneously in the Moluccas, and was from thence carried to Mauritius and Bourbon, French Guiana, and the West Indies. When the Dutch took possession of the Portuguese territories in the East Indies, they compelled the people to destroy the clove trees so as to concentrate the culture in the Amboyna Islands and Ternate.

The clove does not differ in its culture much from the nutmeg. It commences to bear about the sixth year, and continues to yield up to seventy years, yielding about $6\frac{1}{2}$ lbs. of cloves per tree.

After being gathered, the cloves are prepared for shipment by smoking them on hurdles, covered with matting, near a slow wood fire, to give them a brown colour, and they are further dried in the sun. They may then be cut off from the flower branches, and will be found to be purple-coloured within, and fit to be packed in bales for the European market. In some places they are scalded in hot water previously to being smoked, but it is not a practice very generally in vogue.

Cloves are produced in the islands of Zanzibar and Pemba. The total average quantity collected is about 7,000,000 lbs., valued at £85,000. Some years ago a hurricane devastated Zanzibar, and the consequence of this disaster was to destroy nearly every clove tree in the island.

In Brazil the cloves of *Dicypellium caryophyllatum*, which are remarkable for their fine aroma, are largely employed in domestic and medicinal use.

The quantity of cloves received in Holland in kilogrammes were:—

1878	..	..	..	39,100	1883	..	..	..	74,100
1879	..	..	..	38,100	1884	..	..	..	16,700
1880	..	..	..	2,100	1885	..	..	..	46,200
1881	..	..	..	121,600	1886	..	..	..	26,100
1882	..	..	..	18,200	1887	..	..	..	13,700

CARDAMOMS.—Under this name are included the fruit of many species of *Amomum* and *Elettaria*. Those most cultivated for commerce are the Malabar Cardamom, *Elettaria cardamomum*, grown in Madras and Ceylon. This is the most valuable of all the Indian condiments. They are extensively used by the natives for flavouring purposes, and also eaten with *pan*, the native betel compound which is chewed.

The fruit which are obtuse at the ends are known in commerce as "shorts," and those which are tapering as "short longs."

This spice plant is adapted for cultivation in most shady situations, at elevations ranging from 800 to 3000 feet.

The plants may be put out at five feet to six feet apart. In rich cool soil, however, seven feet apart is not too wide, and, moreover, it allows more room for gathering the fruit and cleaning the land. Cardamoms at all elevations require shade; it is better therefore simply to underbrush standing forest or ruinate, leaving light, or broken shade which would admit light, but not the direct rays of the sun.

If seedlings, ten or twelve inches high, are planted they take four or five years to come into bearing. If strong bulbs are planted they come into bearing about a year earlier.

The cultivation is of the simplest and most inexpensive kind. Being grown under shade there is but a small growth of weeds, so that one or two cleanings a year would be quite sufficient.

The cardamom crop is produced on racemes, which lie close to the ground and consist of small greenish pods about half an inch long, which are fit to be gathered when firm and full and beginning to turn of a yellowish colour.

These pods should not be pulled off the plant by hand (as then they split in the curing and lose their value), but they should be cut each singly by a pair of scissors, having a portion of the stalk attached.

The object to be sought in the curing of the cardamom crop is to give the pods when dry a light straw colour, with no black or brown spots. The curing of cardamoms, which resembles that of pimento, is a very simple matter in dry weather: sun drying being the most effective and the cheapest. Care should, however, be taken not to expose the pods too long at first to a fierce sun; a few hours early in the morning and a few in the afternoon being the best treatment. The slower the drying process the better, as then there is much smaller proportion of split fruit.

The yield per acre of cardamom pods in Ceylon is quoted as high as 170 lbs., realizing 2s. 6d. to 4s. per lb., according to quality.

Previous to the commencement of the rains the cultivators (in Southern India) ascend the mountain sides and seek in the shady evergreen forests a spot where some cardamom plants are growing. Here they make small clearings, in which the admission of light occasions the plant to develop in abundance. The cardamom plants attain two to three feet in height during the following monsoon, after which the ground is again cleared of weeds, protected with a fence, and left to itself for a year. About two years after the first clearing the plants begin to flower, and five months later ripen some fruits, but a full crop is not got till at least a year after. The plants continue productive six or seven years. A garden, 484 square yards in area, four of which may be made in an acre of forest, will give on an average an annual crop of 12½ lbs. of garbled cardamoms. Ludlow, an Assistant Conservator of

Forests, reckons that not more than 28 lbs. can be got from an acre of forest. From what he says, it further appears that the plants which come up on clearings of the Coorg forests are mainly *seedlings*, which make their appearance in the same *quasi*-spontaneous manner as certain plants in the clearings of a wood in Europe. He says they commence to bear in about $3\frac{1}{2}$ years after their first appearance. The plan of cultivation above described is that pursued in the forests of Travancore, Coorg, and Wynaad.

In North Candia and West Mysore the cardamom is cultivated in the betel-nut plantations. The plants, which are raised from seed, are planted between the palms, from which and from plantains, they derive a certain amount of shade. They are said to produce fruit in their third year.

Cardamoms begin to ripen in October, and the gathering continues during the dry weather for two or three months. All the fruits on the scape do not ripen at the same time, yet too generally the whole scape is gathered at once and dried—to the manifest detriment of the drug. This is done partly to save the fruit from being eaten by snakes, frogs, and squirrels, and partly to avoid the capsules splitting, which they do when quite mature. In some plantations, however, the cardamoms are gathered in a more reasonable manner. As they are collected the fruits are carried to the houses, laid out for a few days on mats, then stripped from their scapes, and the drying completed by a gentle fire heat. In Coorg the fruit is stripped from the scape before drying, and the drying is sometimes effected wholly by sun heat.—*Pharmacographia*, pp. 644–645.

In the trade returns the lesser cardamom (*Elettaria cardamomum*) and the greater (*Amomum subulatum*) are taken collectively. The value of the exports of cardamoms from India have been as follows:—

1880–81	..	..	..	£.	82,025	1884–85	..	..	..	£.	63,711
1881–82	..	..	..	63,631	1885–86	..	..	..	56,000		
1882–83	..	..	..	40,207	1886–87	..	..	..	40,745		
1883–84	..	..	..	56,833	1887–88	..	..	..	20,486		

The quantity exported ranges from 155,000 to 300,000 lbs.; 27,000 lbs. are sent to Persia.

The value of the cardamoms shipped from Siam was in 1880, £8251, and in 1881, £5671.

Ceylon exported in 1883, 21,656 lbs., and in 1886, 236,056 lbs. There was a remarkable fall in price owing to this large quantity being thrown on the market by the Ceylon planters. At the close of 1877 less than 200 acres of cardamoms were cultivated in Ceylon, while now the returns given are 7000 acres.

In 1878	15,973 lbs. were exported, valued at Rs. 35,398		
1879	17,732 "	"	25,127
1880	17,412 "	"	30,405
1881	16,607 "	"	32,250
1882	20,959 "	"	41,451

SECTION VIII.

TOBACCO.

PERHAPS no other plant is so much used by the inhabitants of the world as tobacco. It has been calculated that one-fourth of the entire human family use it.

To show how extended is the culture of tobacco, even in the British Possessions, at the Colonial and Indian Exhibition held in London in 1886, tobacco and cigars of local production were shown by India, Ceylon, Mauritius, and the Straits Settlements, British North Borneo, New South Wales, Victoria, South Australia, Queensland, Fiji, Malta, Canada, the Cape Colony and Natal, British Guiana, Honduras, Jamaica, Trinidad, Grenada, St. Lucia, Antigua, Dominica, and Bahamas.

Our Colonies and India, it is stated, have to compete mainly with the home-made cigar, and not with the finer qualities of foreign cigars. This fact has caused some authorities to advance the idea that the present system of imposing one uniform duty upon all manufactured tobaccos, whatever may be their value, is unjustly severe upon our Colonial and Indian manufacturers. It is admitted that they cannot compete generally with the Havana and Manila cigars, and the low duty upon unmanufactured tobaccos as compared with manufactured, allows the British manufacturer to produce a cheaper article at home than can be sent from the Colonies and India to England. It is, however, believed that many of the Colonial and Indian tobaccos and cigars have properties of their own that would commend them to a large number of consumers, were it possible that they could be sold in England at a price that would enable them to compete with the British manufacturer.

Production and Consumption.—It is difficult to obtain trustworthy information regarding the world's trade in tobacco, so much is used up locally in different districts. It is probable that the area under tobacco is not far short of 6,000,000 acres.

The following are the official returns of land under tobacco for several countries in 1886 :—

	Acres.
United States	752,520
India	691,700
Austria	4,607
Hungary	144,861
Italy	12,061
France	37,156
Germany	490,321
Holland	3,218
	2,136,444

China, Japan, Africa, Turkey, South America, and many other countries grow tobacco largely.

The following figures show the production of tobacco in several countries according to official returns for 1886:—

	Cwts.
France	436,943
United States	524,030
Germany	760,700
Holland	52,219
Italy	104,062
Austria	49,457
Hungary	918,035
Russia	530,797
Turkey	17,553

The consumption of tobacco in the United Kingdom is large and progressive, as the following table will show:—

Year.	Quantity.	Revenue.	Year.	Quantity.	Revenue.
	lbs.	£		lbs.	£
1840	22,971,406	3,431,908	1870	40,845,253	6,433,147
1850	27,538,104	3,337,258	1880	48,191,555	8,433,538
1860	35,106,641	5,529,400	1888	55,403,875	8,713,944

GENERAL IMPORTS of TOBACCO in 1886.

United Kingdom	lbs.	49,691,309
Russia	poods	76,000
Norway	kilos.	1,842,000
Sweden	"	3,445,253
Denmark	punds	7,406,813
Hamburg	2 cwts.	276,151
German Empire	"	403,964
Holland	kilos.	13,715,000
Switzerland	metrical centners	48,436
Italy	kilos.	23,477,000
Austro-Hungary	metrical centners	175,227
Roumania	kilos.	448,757
United States	lbs.	16,712,000

The only official returns obtainable as to exports of tobacco for 1886 are as follows:—

United States, leaf	lbs.	292,774,000
" manufactured	"	3,266,000
German Empire	kilos.	42,990
Holland	"	1,530,000
China (1887)	piculs of 133½ lbs.	55,522
India (1887)	lbs.	11,440,455

The growth and preparation of tobacco of a superior kind is one that might be carried on advantageously in many of our colonies, and more especially the manufacture of really good cigars, for which there is always a large remunerative demand. The Spaniards have hitherto monopolised this trade, alleging that parts of the soil of Cuba were alone suited to the production of Havana

tobacco. This assertion is now disproved, for with good choice of seed, soil, curing of the leaf, and skilled manufacture of the cigars, Jamaica now sends into the market as excellent a cigar as was ever shipped from Cuba, and at a far cheaper rate.

In the colony of Victoria 2000 acres are under culture with tobacco, and the yield is about 12,000 cwt.

There are some fifty species of the genus *Nicotiana* known, but only three or four are cultivated for the leaf. The two principal commercial forms are by some botanists treated as varieties of one species, and not as distinct species. These are:—

1. *Nicotiana Tabacum*, the most extensively cultivated kind of plant, which may be at once recognised by its longish pink flowers and tapering oval-lanceolate sessile leaves.

2. *N. rustica*, which has short, greenish flowers, and stalked, ovate, cordate leaves. The leaves are coarser, and more crumpled than those of the preceding. This is popularly known as the Turkish form, but it is most probably a native of Mexico and California.

3. *N. repanda*. This is not very extensively cultivated, but is said to yield some of the finest qualities of Cuban and Havana tobacco.

4. *N. Persica* furnishes the Shiraz or Persian tobacco.

5. *N. angustifolia*, a species found in Chili, yields a very strong tobacco.

There is no doubt that the soil and climate have much to do with the quality of the leaf. The West Indian, Latakia and American tobaccos are obtained from cultivated qualities of *N. Tabacum*, while the Manila, Turkish, and Hungarian are reported to be derived from *N. rustica*. The commercial forms of East and West Indian tobaccos are chiefly derived from *N. Tabacum*. In India, *N. rustica* is only cultivated to a very limited extent, and chiefly in Eastern Bengal and Cachar, and the leaf is never exported to Europe. *N. Tabacum* has become an abundant weed in many parts of India.

Climate is a most important condition affecting the quality of tobacco; and this condition has not hitherto been found apart from tropical or semi-tropical countries. The West Indies have always been famous for producing a tobacco more rich in aromatic principle than that grown in most other countries, and this is largely due to their possessing a climate both warm and moist. Hitherto all attempts at producing a leaf possessing the peculiar aroma of the Havana variety in parts of the world other than the West Indies have been unsuccessful. In certain parts of India and Ceylon, however, a cigar leaf is grown which may develop into a formidable rival to that of the West Indies; but at present, owing probably to the excessive amount of potassic nitrate found in the soil, the flavour is in Europe regarded as coarse.

Of all species *N. macrophylla* is considered to possess the qualities that distinguish a good tobacco in the highest degree. Some of the Havana tobaccos belong to this species, as also the Ohio, the

Amersfort, Turkish, and the Dutton tobaccos. The cultivation of this species assumes larger proportions every year, and the number of varieties and sub-varieties increases accordingly.

India.—Madras, where the climate is admirably suited for the growth of tobacco, stands first with regard to the development of the industry. Dindigul is the great tobacco district, and cheroots are manufactured at Trichinopoly. The islands in the delta of the Godavery also yield what is called Lunkah tobacco, the climate being suitable and the plants being raised on rather poor light soil, highly manured and well watered.

In Bombay about 50,000 acres are under culture, in the Punjab over 90,000 acres, in Oudh 70,000, in the Central Provinces 55,000, in Behar 20,000, in Mysore 20,000, in Burma 13,700, and in Madras 73,000 acres. In Bengal, owing to the absence of precise statistical information, the area under tobacco is unknown, but is believed to be over 300,000 acres. The area required for a nursery depends on the area of ground to be planted and on the distance the plants require to be set in the field. To plant an acre with tobacco plants 2 feet apart in each direction, 10,890; 3 feet in one and 2 in the other direction, 7260; and to plant 3 feet apart in each direction 4840 plants are required. To ensure a healthy growth of the young plants, about a square inch should be allotted to each in the nursery. Taking the number of 7260 plants as that required for an acre, and giving each plant 1 square inch room, an area of 7000 square inches, or 50 square feet, would be required to raise plants sufficient for an acre. As, however, the plants are apt to be injured during their first growth, and many are rendered useless in lifting them for transplanting, as also a number of plants must be kept in reserve to replace those that die after transplanting, the provident cultivator will do well to raise double the number of plants actually needed.

It may therefore be laid down that 100 square feet of nursery bed is required to raise plants sufficient for an acre.

The amount of seed required to raise plants for an acre depends chiefly on the vitality of the seed. An ounce of tobacco seed contains about 100,000 grains; so that, on the supposition that a plant can be raised from each grain, nearly seven acres could be planted with the seedlings raised from one ounce of seed, according to the foregoing calculation. As, however, even the best tobacco seed has not a very high percentage of vitality, between half an ounce and one ounce of seed is generally sown to produce the plants required for an acre. The soil of a tobacco nursery cannot contain too much organic matter; it is said that one containing as much as 20 per cent. of this substance produces the most vigorous plants, which develop a great number of fibrous roots. The time of planting out necessarily varies in different localities and climates. Where the rains are very heavy in India, the time for sowing is immediately after the heavy rain of the monsoon is over. In about seven weeks after sowing, the plants will be fit for transplanting.

The gross annual value of the tobacco harvest in Bengal may be roughly estimated at £2,000,000 sterling a year. The average

annual value of the export in the three years ending 1888 was £130,000, but foreign cigars and tobacco are imported to the value of £100,000.

In 1881, the exports from India were as follows:—

	Lbs.
Manufactured leaf	13,167,325
Cigars	207,005
Other manufactured tobacco	198,811
	13,673,141

Of the unmanufactured tobacco—

	Lbs.
Bengal exported	7,866,363
Bombay	4,628,078
Other places	772,884
	13,267,325

United States.—The production of tobacco is liable to great variation, as it is a very delicate plant, the prey of adverse conditions and insect ravages.

The average production in decennial periods has been as follows:—

	Lbs.		Lbs.
1839	219,163,319	1869	262,735,341
1849	199,752,655	1879	472,661,157
1859	434,209,461		

In the two decades for 1868 to 1887 inclusive, the annual product ranged from 315,000,000 to 580,000,000 lbs., and the range of price was 7·6 to 11·4 cents. In 1886 the tobacco crop of the United States was a medium yield of something over 500,000,000 lbs., and the quality was fairly good.

In 1887 the average yield per acre in the chief producing States was, in Maryland, 638 lbs.; in North Carolina, 485 lbs; Tennessee, 430 lbs.; Kentucky, 509 lbs.; Ohio (including seed leaf), 615 lbs.; Indiana, 397 lbs.; Illinois, 403 lbs.; Missouri, 500 lbs.

The distribution of American tobacco is world-wide, including nearly all the countries with which the United States has any trade. The current average export in the five years ending 1886 was as follows, to—

	Lbs.
Germany	49,685,100
Great Britain	44,918,612
France	32,363,595
Italy	29,259,714
Netherlands	15,568,326
Spain	24,427,794

The home consumption in America is larger than the export.

The value of the crop produced in the year 1886–7 was 39,082,112 dollars, and of the tobacco exported, 20,510,386 dollars.

A large amount of the finest tobacco found in the market is from the fields of Ohio. The eastern and south-eastern part of the State affords the best soil for tobacco growing, and in these

districts this product has become a staple article, affording the main crop of the farmer, and, as a rule, rarely failing pecuniarily, for, even in seasons when the yield is small, the price of the article is proportionately large.

In growing this much-used plant, the first step is the preparing of the ground for sowing the seeds, by burning logs of wood or brush on the section of land chosen for tobacco beds. This is done to warm the soil, as well as to supply the ashes needed in nourishing the young plants. The burning takes place either in the fall or spring previous to sowing. If in the fall, the ground is slightly reburnt in the following spring. The time required for burning the beds, if logs of wood are used, is generally from two to three days; if brush be used, a much less time. The earth is then dug up and raked to a proper consistency. After the seeds have been deposited, the bed is thoroughly tramped or walked over, in order that it may retain sufficient moisture. In about three weeks the young plant makes its appearance; but it remains quite small for a considerable length of time, and, in fact, the growth is hardly noticeable from the time of its appearance above ground (about the 1st of April) until shortly before transplanting, which is generally about the latter part of June. It then grows with astonishing rapidity, as, when transplanted, it may have been but from 1 to 2 inches in height; when ready to collect (the latter part of August), it generally measures from 3 to 6 feet, and not unfrequently 10 feet in height. The transplanting of tobacco is not unfrequently attended with much difficulty, dry weather being very detrimental to the plant and too much moisture equally as injurious. In the former case the young plants wilt and die, and in the latter instance the earth becomes hard and baked around the roots of the vegetable, thus killing it. The ground is considered to be of the proper consistency for transplanting after it has been thoroughly moistened by rain.

Tobacco is collected from the last of August until the last of October, until frost, and, if planted late, this unwelcome visitor often finds a large crop not matured, which is consequently worthless after the first touch of its icy breath. In collecting tobacco, the first leaves gathered are called "bottom leaves," being from five to seven of the lower leaves of the plant, after which the plant is "topped," thus producing larger leaves, and causing maturity in a much quicker time. This topping process strengthens the plant materially, as, after its performance, new shoots or branches will almost always spring from the axils of the leaves nearest to where the tops are broken off, and often afford leaves large enough to be gathered.

The next in order are the middle leaves, which are collected in about two weeks after taking the bottom leaves. They consist of from ten to twelve leaves from the central part of the plant, and are the largest as well as the most valuable ones of the plant. Finally, the top leaves are collected, in from three to four weeks after taking the middle ones, provided there is no frost to injure them. These are smaller than the middle leaves, and resemble

very much those taken from the bottom part of the plant, but are cleaner than these latter, which often become very much soiled from their close proximity to the soil.

Among other points in cultivating tobacco, may be mentioned the worming process, which, to most persons, is an exceedingly unpleasant task. The worm which is found on the plant is not very attractive in appearance, nor agreeable to handle. It is of a green colour, and, when full-sized, measures about 1 inch in circumference and from 2 to 3 inches in length.

After collecting the tobacco, it is taken to the tobacco house, and strung upon sticks (by means of a large needle and twine), called "tobacco sticks." Women are employed for this work, who string from one hundred to one hundred and twenty-five sticks per day. It is then placed on the tobacco scaffold, in the open air, until wilted, when it is taken to the tobacco house, where a gradual heat is applied until it assumes a yellow colour. A higher degree of heat is then immediately applied for twenty-four hours, to "kill it," as the farmer terms it, meaning the expulsion of all moisture from the leaves. The doors of the house are then thrown open, and the floor often sprinkled with water, in order that the leaves may again become sufficiently moistened to permit manipulation. It is now rolled in bundles ready for market.

The main object sought for by tobacco growers is the colour, which is influenced by various causes; among the leading ones are the modes of drying and the soil upon which it was raised, as the first crop of tobacco on any soil is invariably the finest. The "yellow spangle" is considered the finest colour, and consequently brings the highest price. The "light red" also stands high in the list, and is deemed a valuable colour. There are several other colours besides the two named, which go to make up the tobacco seen in commerce.

The seeds which have been collected the previous autumn are sown in early spring in cold frames. These frames consist of large oblong boxes, without bottoms, 2 or 2½ feet deep by 3 feet wide, and covered with glass. They are prepared in autumn by being filled with rich earth and fertilisers. In selecting a site for these frames, a sheltered spot having a southern exposure is preferred. They are additionally protected from the weather by being covered with straw, &c. Persons making "plant raising" a specialty sow as early as the 15th of February. After sowing, the frames are covered with glass alone during the day, and sheltered at night. The earth being kept moist, the seeds soon sprout, and the little plants appear. Additional care must now be taken to admit the sun during the day and to protect them from the frosts at night. Persons not desirous of having plants early or for sale, do not take the precautions above enumerated, nor do they sow as early. A warm, sunny spot, having a rich soil or one enriched by fertilisers, is sufficient for their purpose.

When quite young, the plants are frequently infested by the "plant louse," an insect belonging to the genus *Aphis*.

When the plants have attained the height of several inches, they are transplanted to the fields. This is rarely done before the 15th of May to the 1st of June. The fields are ploughed the previous autumn, as by so doing it is thought that some of the insect enemies are destroyed. In the spring the soil is loosened and then ploughed in such a manner as to form ridges one half to a foot high, at a distance of 4 to 5 feet apart. The plants are planted on the tops of these ridges, at a distance of 2 to 3 feet. A wet day is chosen, as the plants require much moisture to continue their growth without interruption, for at best a large percentage die, owing to want of sufficient care in planting, or the ravages of the "cutworm" (different species of the genera *Agrotis*, *Gortyna*, &c.), which is the principal enemy at this period of its growth. They are concealed in the earth during the day, and go on their errands of destruction at night, cutting off the plant while it is young and succulent.

After the plants have been thoroughly rooted, one of the principal objects is to keep down the weeds, which grow luxuriantly in the rich soil. This is accomplished by hoe-harrowing and the hand hoe until the plant grows too large to admit the passage of a horse and harrow without injury to the leaves, after which the plant is strong enough to suppress the weeds, when it grows very rapidly, soon attains the height of 3 or 4 feet, and puts forth the flowering head. This is broken off when leaves are the object of the cultivator; but, when seeds are desired, the inflorescence is left to develop. Cultivators differ as to the proper time to "top" or break off the flower head. Some prefer to top when the stem has six or eight leaves, while others think ten not too many. After being topped, axillary branches are put forth, which are popularly known as "suckers." These are broken off as soon and as often as they appear. The whole plant is now covered by a viscid resinous substance commonly called "gum," which renders it unpleasant to handle.

When tobacco is ripe, or fit to cut, it assumes a peculiar yellowish-green colour, and when the under side of the leaf is bent it is brittle and breaks easily. When in proper condition to be gathered, it is cut off close to the ground, and hung up to dry. Various methods have been proposed for hanging it up, but the most approved, and the one generally adopted, is to pierce the base of the stem by a steel spear, in which is fitted an ordinary plastering lath. By this means five or six stalks are slipped on one lath, and handled and hung up as easily as one. The largest growers have sheds built purposely for drying and curing. These are closed in by alternate boards, hung on hinges, so that they may be opened for the free circulation of air on favourable days. Tobacco when dried and cured is of a brownish-yellow colour, very crisp and brittle, and easily broken when handled, but when moistened it becomes quite pliable.

After the 1st of December the tobacco is "stripped." By this is

meant the separation of the leaves from their stems. They are then assorted into two grades, viz., "fillers" and "wrappers." The former consist of "ground" leaves, and those which have been torn or worm-eaten; the latter wholly of fine perfect leaves. These names are derived from the relative position the grades take in cigars. The different grades are then bound into small bundles by wrapping one leaf around the bases of a dozen others. After being pressed in cases, it is ready for market.

A high price is generally commanded, irrespective of the species, by those tobaccos that possess a large, smooth, thin leaf, which is elastic, and has a fine golden colour, and a good aroma; the ribs and veins should be thin, and the former branch off from the mid-rib at nearly right angles, and be far apart from each other. The lower the percentage of the weight in ribs, the thinner and broader the leaf, the fewer of the same that are torn, the more wrappers can be cut out of 1 lb. of tobacco, other conditions being equal, and consequently the higher is the price of the article.

Algeria.—The cultivation of the tobacco plant has been carried on very successfully for the last thirty or forty years in this French province, the soil and climate being well suited to its growth. The production in 1887 was 5,000,000 kilos. from 10,239 hectares. The quantity exported was 612,724 kilos. of manufactured tobacco, valued at 3,241,985 francs, and 4,316,677 kilos. raw in leaf, valued at the same number of francs.

In 1888 France produced 24,967,261 kilos., of which Algeria furnished 2,688,295 kilos.

The yearly production of tobacco in Cuba is about 300,000 bales; 181,353 bales of raw tobacco were exported in 1886, besides over 181,000,000 cigars. In the Philippines 100,000 cwts. of tobacco are produced.

The Dutch possessions in the Eastern Archipelago produce a large quantity of excellent tobacco, which is held in high repute in Europe and the United States of America.

The following figures show the receipts of Sumatra tobacco in the Netherlands in the five years ending 1888 :—

	Packages.		Packages.
1884 (Crop 1883) ..	93,504	1887 (Crop 1886) ..	138,631
1885 (" 1884) ..	125,476	1888 (" 1887) ..	139,470
1886 (" 1885) ..	124,721		

The districts where it is grown are Deli, Langkat, Serdang, Padang, Bedagie, Batoe Bara, Bela, Pagoerawan, and Asahan; the first three being the largest producers.

The exports of tobacco from Java were as follows:—In 1878 and 1879, average 14,071,000 kilos.; 1880 to 1884, 10,092,000 kilos.; in 1885, 10,472,000 kilos.; and in 1886, 10,111,500 kilos.

The receipts of Java tobacco at Amsterdam and Rotterdam, in 1888, were as follows, in bales of about 76 kilos., in all nearly 10,000,000 kilos. :—

LEAF TOBACCO.

Districts.					Prime or Wrappers. Bales.	Ground Leaves or Fillers. Bales.
Kedirie	..	..	..	..	8,216	17,302
Probolingo	..	..	..	..	10,517	9,736
Bezoeki	..	..	..	..	31,826	28,805
Vorstenlanden	..	..	..	..	10,662	4,850
Banjoemas	..	..	..	..	6,384	1,250
Pasaroean	..	..	..	..	286	3,446
Rembang	..	..	..	..	2,508	784
Soerabaia	..	..	..	..	144	233
Samarang	..	..	..	..	177	533
Madioen	..	..	..	..	81	..
Kadoe	..	..	..	..	319	..
Moluccas (Batjan)	..	..	..	..	398	..
Celebes (Menado)	..	..	..	..	199	108
Borneo	..	..	..	..	31	280
					62,748	67,327

With the extensive culture and production of tobacco in the European States I have not to deal in a work treating specially on Tropical Agriculture, but I may state that there were 176,168 tobacco planters in Germany in 1886, who had 490,321 acres under culture and the yield in pounds of shed-dried tobacco was, 85,198,427 lbs.

The average annual consumption of tobacco per head in various countries, according to the latest calculations, was as follows :—

	Lbs.		Lbs.
Holland	6·92	Finland	2·73
United States	4·40	Norway	2·29
Austria-Hungary	3·72	France	2·05
Denmark	3·70	Sweden	1·87
New South Wales	3·53	Tasmania	1·85
Queensland	3·49	New Zealand	1·75
Western Australia	3·26	Spain	1·70
Switzerland	2·24	United Kingdom	1·41
Belgium	3·15	Italy	1·34
Germany	3·00	South Australia	1·32
Victoria	2·93	Russia	1·23

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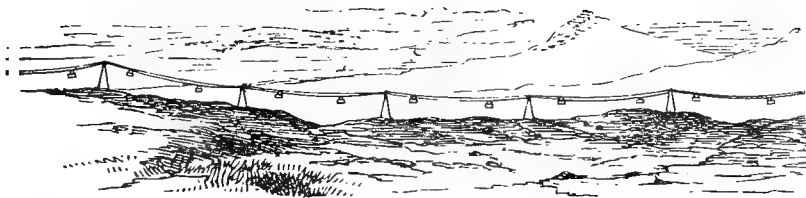
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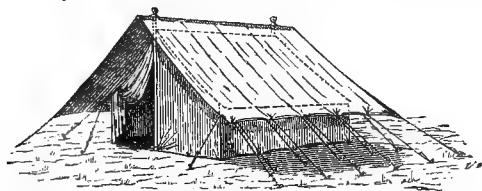
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